RADIO *and* ELECTRICAL *Review*

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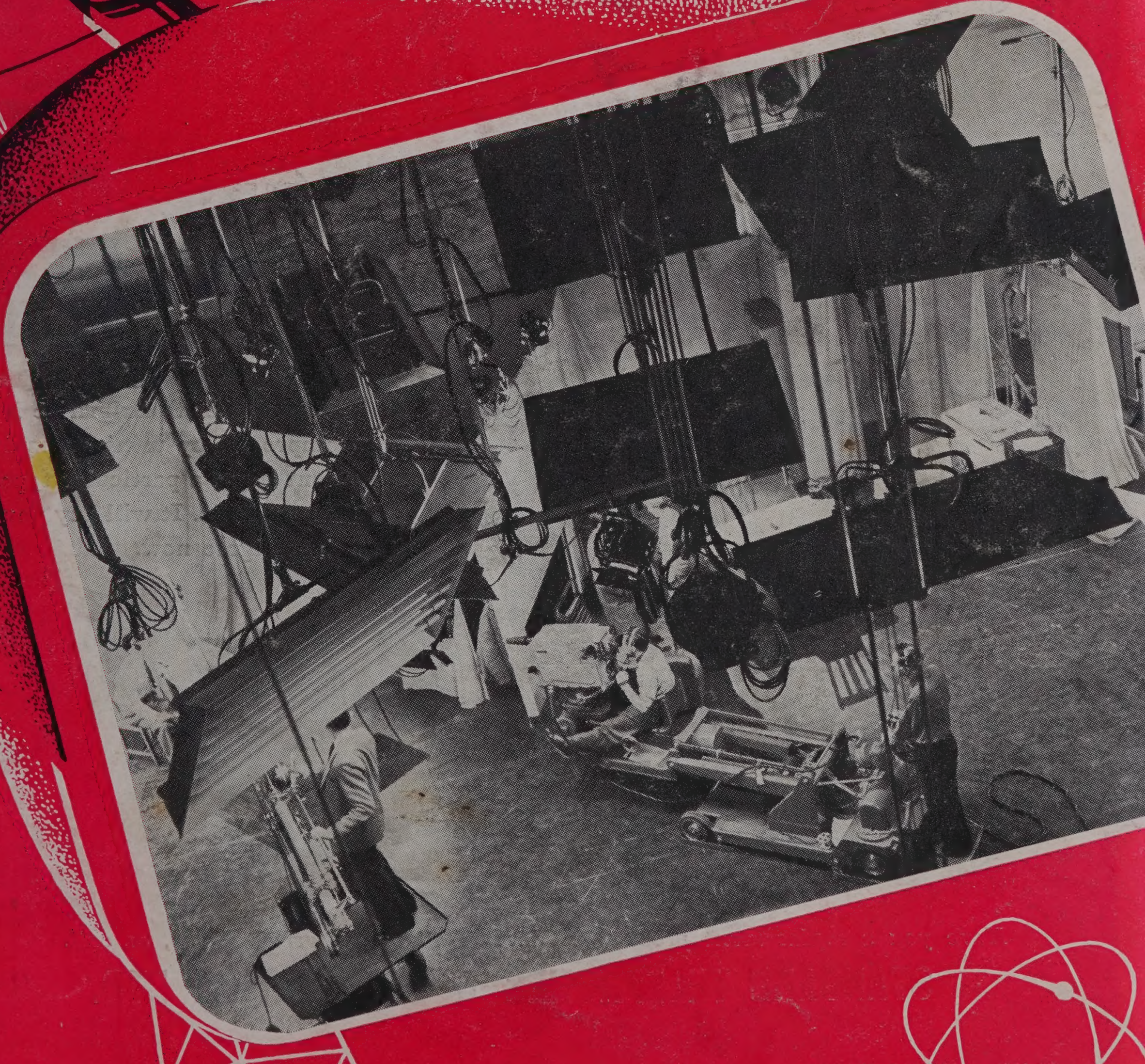

MARCH 1st 1956

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Radio and Electrical Review

OUR COVER PICTURE this month depicts Associated Rediffusion's new Wembley Television Studio No. 1 from the lighting control position, showing a Marconi television camera on the studio floor and the "bath tub" fluorescent lighting equipment with telescopic suspension from the lighting grid.

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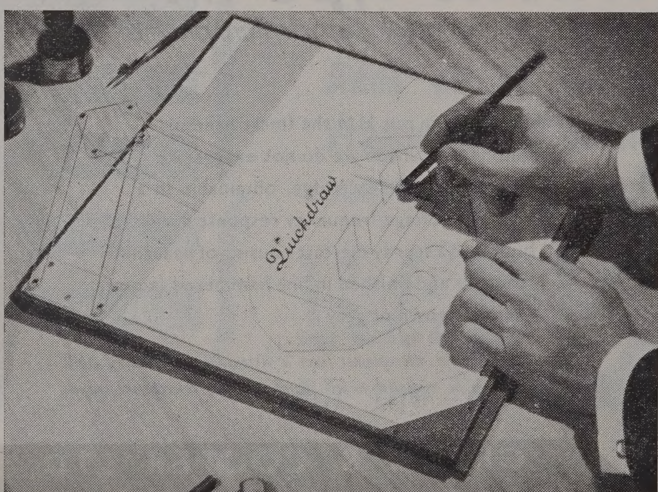

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COLOUR TELEVISION IN BRITAIN

Readers of British technical periodicals will no doubt have been struck by the fact that a few months ago, the B.B.C. commenced some experimental transmissions of colour television. These transmissions, it was stated, were intended purely to gather technical information, and were carried out on Band 1 (41 to 68 mc/sec.) using a system compatible with the existing 405-line monochrome transmissions. The system was a modification of the N.T.S.C. system as used for colour transmission in America, employing the same method of frequency-interlacing to enable the colour signals to be transmitted within the same bandwidth that is used for black-and-white transmission. As far as it is possible to tell from comments in our contemporary "Wireless World", the transmissions have consisted of no more than bars of colour, which appear on monochrome sets as bars of various shades of grey. The transmissions showed that on many sets, no dot structure was clearly visible, and tended to indicate that on the score of compatibility, viewers would have little to complain of.

It is somewhat surprising, then, to find in the newspaper, dated 10th February, a statement that Britain's Postmaster-General is about to announce plans that have been made for a colour television service. The article states that the Television Advisory Committee has recommended that colour TV should be broadcast on a waveband other than those used for the present monochrome transmissions, so that it will be a completely separate service from the one viewers are receiving now. The report is somewhat vague, but mentions that colour will be broadcast in such a way that the receiving sets used will be saleable abroad, as well as in the United Kingdom. There is also a mention of a higher standard of definition.

Adding all these points together, it would appear that the colour broadcasts will be on the C.C.I.R. 625-line standard, and will use the U.H.F. Bands 4 and/or 5 (470 to 585 mc/sec., and 610 to 960 mc/sec. respectively). This is all very interesting, and although the points mentioned will not be official until the P.M.G. has issued his official statement, various possibilities appear to exist. For example, there was no mention of the question of compatibility. As far as the present 405-line system is concerned there will obviously be none, but we refer to the compatibility of the colour system with a hypothetical black-and-white system that could be broadcast on the same R.F. channels. Although the Americans have clung to compatibility as an essential plank in the colour platform, informed opinion in Britain, where there are as yet no colour commitments, seems divided on the point. Some engineers, for instance, doubt whether given the choice, a compatible system is not less desirable than a non-compatible one. They are certainly not sure that a frequency-interlaced system is the best compatible form, particularly if spectrum space allows the colour information to be broadcast on a different R.F. channel. However that may be, it is interesting to speculate what may lie behind the decision (if such it is) to go to a new standard and a new RF band for the colour service when it is inaugurated. It is possible that the planners may be inserting a colour wedge, as it were, the thin edge of which will be the institution in due course of colour broadcasts, but of which the thick end, as yet barely visible, will be the transference of the black-and-white service to the 625-line standard. If the colour broadcasts are made compatible, their existence would surely open the way for the dropping of the present 405-line transmissions at some date well in the future. If this idea lies behind the scheme for colour, it is a very shrewd one, which may well be the means of ultimately removing a technical standard that will prove an embarrassment sooner or later, if it is not one already.

Mr. C. O. Stanley, Chairman of the Pye organization, and a very outspoken critic where he thinks criticism necessary, has publicly expressed the view that the British television receiver industry is being badly handicapped by the continued existence of the 405-line standard. His argument is that if Britain had the C.C.I.R. standard, she would be able to export sets whose design is suitable also for the home market, and that this would result in considerable export business which is at present going begging, because manufacturers cannot economically produce sets for export that are so different from the ones they must build for home consumption.

In view of the reported non-success of colour television on a commercial basis in the United States (see elsewhere in this issue), it does seem a little strange that the powers that be are thinking of its introduction in Britain, especially at a time when there are only about four million licensed sets there already, although over 90 per cent of the population is served with TV transmissions. It is difficult for us at this distance, to evaluate the motives behind a desire to institute colour television, but it is impossible not to admire the pioneering spirit which prompts it, in both Britain and America, especially when we cannot even begin to think about television at all!

High-quality Reception

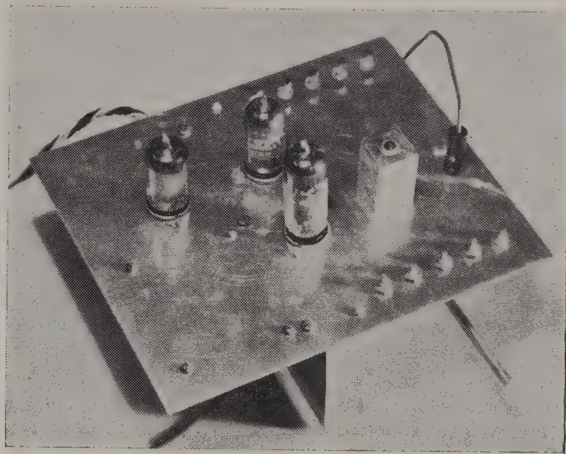
THE "JUNIOR" SYNCHRODYNE TUNER

The article below describes a simplified version of the synchrodyne, which is easier to build than the original one described in these pages, and which has a performance in no way inferior to it. Inclusive of a built-in audio pre-amplifier, the new circuit contains only three valves.

INTRODUCTION

Although it is some time now since we published the details of our original synchrodyne circuit, its popularity among radio enthusiasts has showed no signs of waning. We have no doubt, however, that many of those who have heard the superb results given by the synchrodyne, and who would like to have one themselves, have been put off somewhat by the complexity of the original circuit, and by the apparent trickiness of the arrangement. For some time, therefore, we have been searching for some means of widening the appeal of the synchrodyne principle by making one which contains less construction and fewer features which may give the constructor trouble. Recent experiments in our laboratory have shown that the sensitivity of the original model was higher than was strictly necessary, and that the two-stage R.F. amplifier is by no means essential.

In addition, the original circuit used EF50 valves, which are somewhat out of date, because at the time at which the circuit was devised, EF50s were available at a give-away price. It was felt, therefore, that a new circuit should be available, using the most modern valves. The advantages thus obtained are those of compactness and ease of valve replacement over a long period. Accordingly, the new design uses the modern noval-based valves, and it has been possible to effect a considerable reduction in the size of the unit.



General View of the Unit

DESCRIPTION OF THE CIRCUIT

There may be some of our readers who have not yet become familiar with the synchrodyne principle, so that, for them, a brief description of what goes on inside this still novel type of receiver will be essential. Meanwhile, we will have to crave the indulgence of those many readers who will find this part of the story "old stuff."

The heart of the synchrodyne is the special detector, or demodulator circuit, that is used in it. This can be identified on the circuit diagram as the portion comprising the transformer (coupled to the plate circuit of the R.F. amplifier on the input side, and to the four-diode detector circuit on the output side), the four crystal diodes, and the 3.3k. load resistor. This circuit is known, after its inventor, as the Cowan demodulator circuit, and it has rather special properties compared with conventional detector circuits, which rarely use more than one diode.

It will be noticed that the demodulator circuit has two inputs. One consists of the R.F. signal from the R.F. amplifier valve, and this is provided by the transformer, whose primary is in the plate circuit of the R.F. amplifier valve. The secondary of the transformer is a balanced, or push-pull, one, and feeds two R.F. voltages to the diode network, these voltages being 180 degrees out of phase with respect to each other. The second input is from an R.F. oscillator, whose frequency is exactly the same as that of the carrier we wish to receive. The oscillator voltage is applied to the diode circuit between the centre-tap of the transformer secondary and the junction between two fairly large condensers which are connected across the diode circuit. In this way, the oscillator voltage is applied in the same polarity (or phase) to each half of the diode circuit. Now let us see in an elementary sort of way how these two R.F. inputs act on the demodulator circuit.

First of all, imagine that only the R.F. input is present, and that the oscillator is out of action. We have a positive half-cycle of the R.F. voltage applied to the diode junction A, and at the same time a negative half-cycle applied to the diode junction B. The first of these voltages causes a current to flow through diode No. 1 and downwards through the 3.3k. resistor. The second causes a current to flow through diode No. 3 through the load resistor, and in the same direction as the first. Thus, a current flows downwards through the load resistor, half of it coming from each half of the push-pull transformer secondary winding. During the next R.F. half-cycle, however, the potential at A is negative, and that at B is positive. Here, then, diodes 2 and 4 conduct, and allow a current to flow in the load resistor in the upwards direction. For half an R.F. cycle, then, current flows one way through the load resistor, and for the other half of the cycle an equal current flows through the load resistor in the opposite direction. But, averaged over the whole R.F. cycle, the net current in the load resistor is zero, so that, although two of the diodes are working at all times, the average

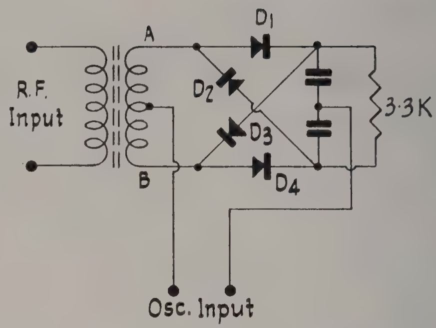
current in the load resistor is zero, and no detecting action takes place. This action will only be perfect if the circuit is accurately balanced. That is to say, the voltages from each half of the transformer secondary must be equal, and the characteristics of all four diodes must be the same.

If now we imagine that no R.F. signal is coming in from the transformer, but that the oscillator is working, we find a different state of affairs. This time we find that the R.F. voltages applied to the diode junctions A and B are in phase with each other; thus, if the R.F. is producing a positive potential at A, it is producing the same positive potential at B, at the same time. In this case, diodes 1 and 4 will conduct simultaneously, and equal currents will flow **in opposite directions** in the load resistor. When the polarity of the input voltage changes over, as it does in the next half-cycle, diodes 2 and 3 conduct, and the same thing happens. It can be seen, therefore, that, with the oscillator voltage alone applied to the circuit, there is still a net zero current through the load resistor, and no detecting action takes place.

But, when both signals are applied to the circuit together, things are quite different. In practice, the voltage from the oscillator is always made much larger than the signal voltages from the transformer. We must also remember that the oscillator voltage is of exactly the same frequency as the signal voltage. Thus, what happens is that the oscillator acts as an automatic switch, allowing two of the diodes to conduct, and cutting off the other two, during each R.F. half-cycle. Let us see what happens when both voltages are present, and when the oscillator voltage at A and B is positive in polarity. Under these conditions, diodes 1 and 4 will be conducting, and diodes 2 and 3 will be cut off.

Now let us suppose that when the oscillator voltage has this polarity the signal voltage is making A positive in potential, and B negative, remembering that the signal voltage is small compared with the oscillator voltage. The voltage appearing at A will be of the same polarity, therefore, as the oscillator voltage (i.e., positive), but will be slightly greater in amplitude, because the signal and oscillator voltages in this case add. At B, the polarity will still be positive, but will be slightly less in amplitude than the oscillator voltage, since on this side of the circuit the signal is out of phase with the oscillator. Thus, if we represent the peak oscillator voltage by 0 volts, and the peak signal voltage as s volts, we have at A $(0 + s)$ volts, and at B $(0 - s)$ volts. These voltages will attempt to pass a current through the load resistor in opposite directions, so that the net voltage acting in the resistor will be the difference between the two —namely $(0 + s) - (0 - s)$, which equals 2s. This will act in such a direction as to drive the current **downwards** through the load resistor.

On the next half-cycle, both signals are reversed in polarity, so that at A the voltage will be $(-0 - s)$, and at B it will be $(-0 + s)$. This time the net voltage attempting to drive current through the load resistor will be $(-0 - s) - (-o + s) = -2s$. Thus, the effective polarity across the transformer secondary is reversed. This time, however, diodes 2 and 3 can conduct, and 1 and 4 are cut off; so, although the polarity of the effective transformer voltage is reversed, so are the diode connections, which are crossed over. As a result, the current flows in the diode load resistor **in the same direction as before.** We see, therefore, that when both signals are applied to the circuit simultaneously, current flows



Basic demodulator circuit, to which the description in the text refers.

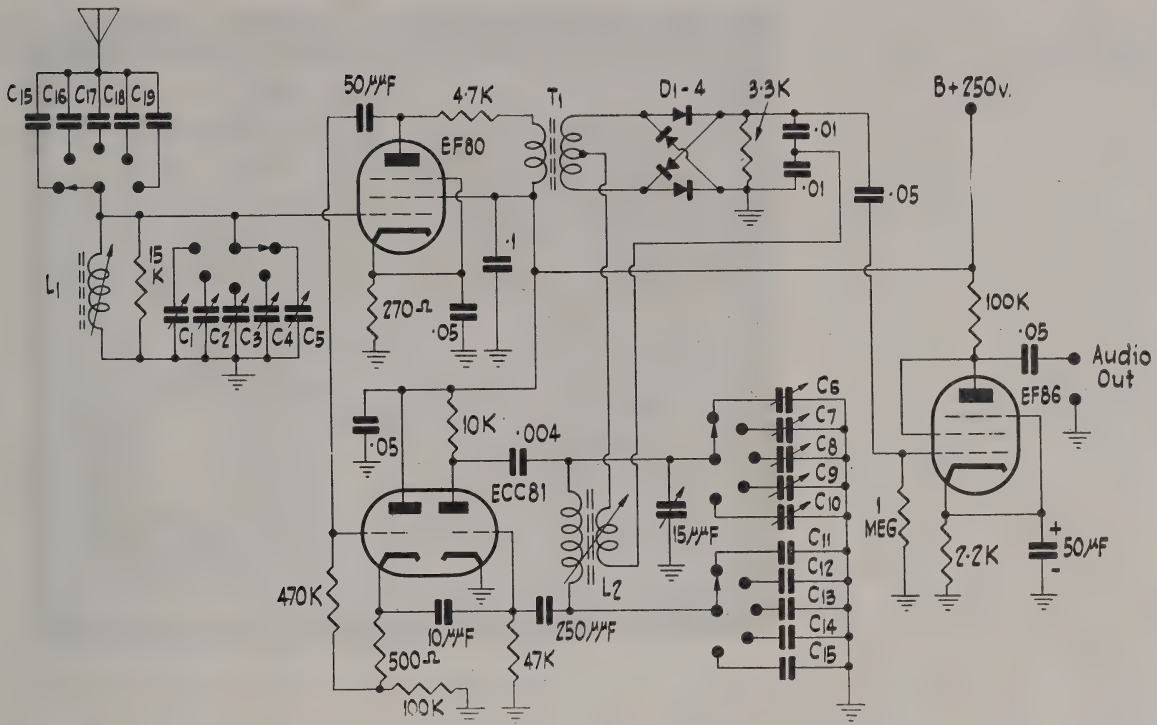
in the same direction in the load resistor at all times. Rectification therefore takes place, and the signal is detected. As the amplitude of the signal voltage changes (since it is modulated), so does the current through the load resistor, so that the modulation is obtained as a voltage across the load resistor.

From this description, it can be seen that the process of detection in the synchrodyne depends on the presence of the oscillator voltage, at exactly the same frequency as the carrier that is to be received. If this is absent, there is no audio output. By the same token, if a second signal is present, close to the signal that is wanted, it will not be detected, and will not show up as an interfering signal. It is in this manner that the synchrodyne obtains its selectivity. At the same time, there is nothing in the circuit that can prevent the highest modulation frequencies belonging to the wanted signal from being reproduced. In this way, the synchrodyne is able to give substantially perfect reproduction of the wanted signal, and yet is selective enough to separate signals that are quite close together.

Another way of regarding the synchrodyne is as a superhet whose I.F. is zero c/sec. The oscillator signal then beats with the sidebands of the received signal, producing new sidebands at audio frequencies. Since the new sidebands are the actual audio frequencies represented by the modulation, this sort of superhet requires no second detector. The special kind of detector circuit is needed to prevent the R.F. amplifier and detector from acting as a simple T.R.F. receiver. In some synchrodynes, the balancing-out action of the demodulator circuit will not be perfect, as described earlier, so that if the oscillator is put out of action, it will be possible to hear the signal because of the T.R.F. action. Usually, this will be much weaker than the proper signal when the oscillator **is** working, and, in any case, there is no need to worry about it, as it will not spoil the working of the tuner. This is because the T.R.F. action disappears almost entirely as the oscillator is brought into tune with the signal.

OSCILLATOR LOCKING

We have seen that in the synchrodyne the oscillator must work at **exactly** the frequency of the signal to be received. If it did not, several undesirable things would happen. First, the audio frequencies produced by the detector would not correspond to the modulation frequencies, but would be displaced by an amount equal to the difference between the carrier and oscillator frequencies. If this difference is only a few cycles



C_1–C_5, 400 $\mu\mu$f. padder condensers for aerial tuning.

C_6–C_{10}, Philips trimmers, with fixed capacity in parallel.

C_{11}–C_{15}, fixed capacities equal respectively to those of C_6–C_{10}.

D_1–D_4, any general-purpose Xtal diodes.

L_1, standard aerial coil, with primary unused.

L_2, standard oscillator coil. The secondary winding is the tickler, used in this case as an output coupling winding.

T_1, wide-band R.F. transformer, see text.

per second, the resulting sounds are very strange indeed, and are not very much like music! Another effect would be that the difference between the carrier and oscillator frequencies would appear in the audio section of the receiver as a low-pitched growl, which would be quite intolerable. How, then, is the local oscillator made to work at exactly the same frequency as the signal carrier? It is done by feeding a small amount of the signal into the oscillator circuit, thus causing the latter to become synchronized with, or locked to, the frequency of the carrier. It is this feature that gives the synchrodyne its name.

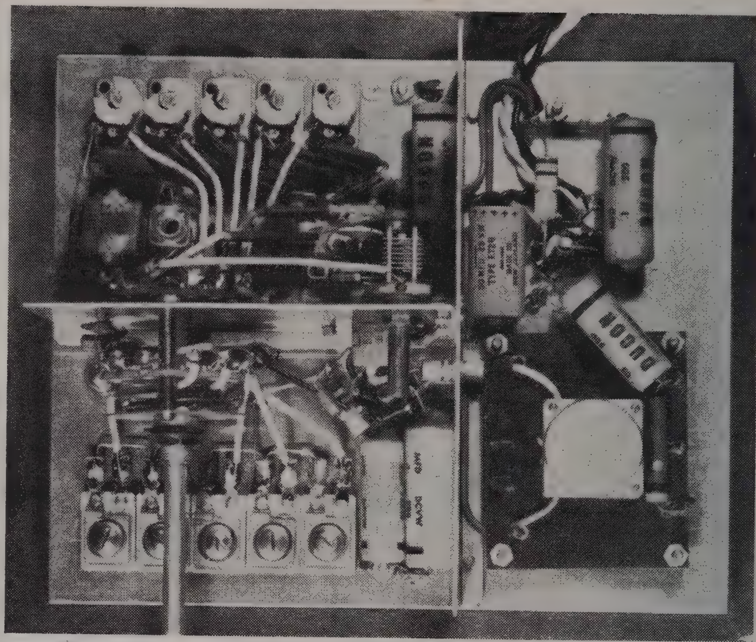
Locking an oscillator is not such a difficult thing as might be imagined. Indeed, there are many oscillator applications in which preventing an oscillator from locking to another frequency quite close to its own is considerably more difficult than is locking one on purpose. Perhaps the most commonly observed example of oscillator locking is to be found in the common or garden regenerative detector. Everyone who has operated one of these will remember how, when the detector is oscillating, and is tuned through a signal, a heterodyne squeal is heard first at a high frequency, and then decreasing in pitch. At some quite low frequency, the note suddenly disappears instead of carrying on to still lower frequencies. The disappearance of the beat note is because the oscillating detector has synchronized itself with the incoming signal. As the tuning of the detector is continued, the beat note suddenly re-appears when the oscillator falls out of lock with the signal. If the regenerative receiver is well made, and stable, it is not too difficult to set it so that it is oscillating in synchronism with the incoming carrier, where it will remain until disturbed.

THE R.F. AMPLIFIER

In the original synchrodyne circuit, the R.F. amplifier consisted of a pair of high-Gm pentodes (EF50s) resistance-coupled, and with negative feedback from the output of the second stage back to the input of the first. This arrangement gave more gain than a single stage, but, because of the feedback, not as much as two stages. The purpose of the feedback was both to reduce the gain to manageable proportions, and to reduce the distortion in the R.F. amplifier as a whole. Here, a single stage is used, and its cathode is bypassed in the usual way, because its distortion under most circumstances is low enough without the negative feedback that omitting the condenser would provide.

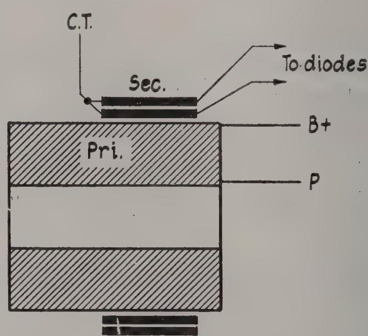
To guard against intermodulation between strong signals that might be present on the broadcast band together, a broadly tuned circuit is provided at the grid of the R.F. stage. The selectivity of this circuit is not great enough to have any effect on the audio frequency response, as it does not have to be selective enough to try to separate stations close together

in frequency. This function, as already explained, is fulfilled admirably by the synchrodyne circuit itself. The R.F. output transformer is a wideband one, similar in principle to an audio transformer, but designed to have a level response over the whole broadcast band. It is wound on a Ferroxcube pot core, type D25/17.5/111b$_8$. In the previous design, a slightly different grade of Ferroxcube — namely, IIIb$_1$—was used. This is the grade identified by an orange spot on the core. At present, however, this grade was found to be unavailable, and so the IIIb$_2$ material was used. For wide-band transformers such as this, the differences between the various subdivisions of Ferroxcube III are so slight as to be negligible. This was borne out in practice, because in using the different core material, it was found that no change was required in the number of turns on the windings. The latter are put on the bobbin provided with the core in the manner illustrated in the diagram.



Under-chassis view of the tuner showing layout of the main parts.

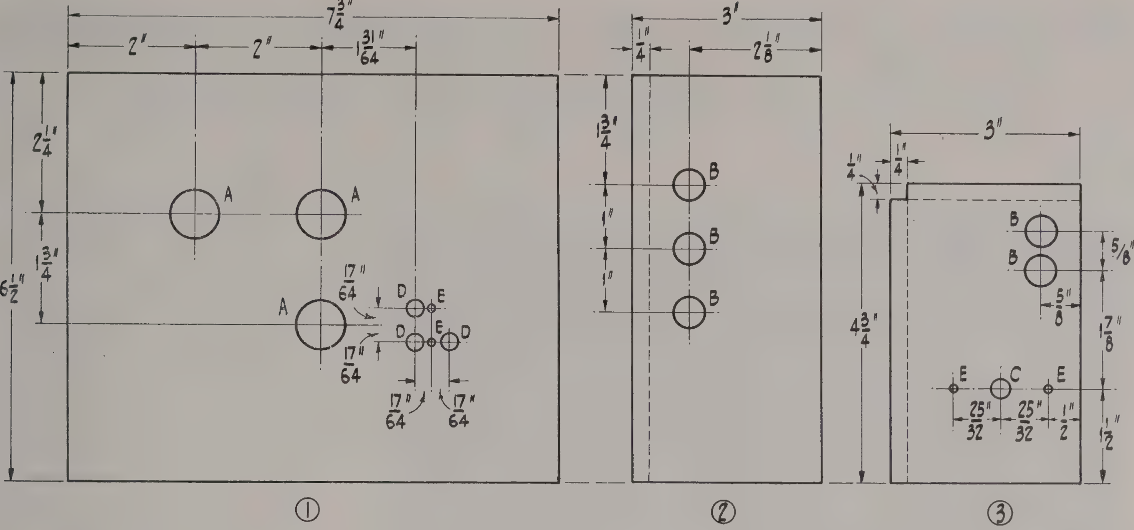
The primary, of 70 turns of wire about 24 gauge, is put on first. The secondary consists of 14 turns each side, and is wound in two layers, as shown, with the centre-tap brought out at one side. The second layer of the secondary is wound in the same direction as the first, but is wound back over the first layer so that the ends of the whole winding both come out at the same side of the bobbin. It is important to mark the start and finishing ends of the primary, and to use the inside end for the connection to the R.F. tube's plate, and the outer end for B, as illustrated. This makes the transformer self-shielding, and eliminates the need for an electrostatic shield between the two windings. The EF80 is one of those R.F. pentodes which can be operated with the same screen voltage as plate voltage, which accounts for the lack of a screen dropping resistor. However, for safety's sake, a screen bypass condenser is used, connected right at the screen pin on the valve socket.



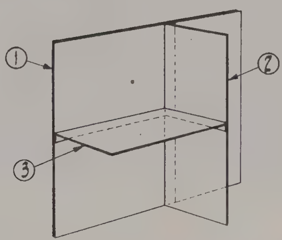
Method of winding used in making the wide-band transformer.

It will be noted that there are two switch sections in the aerial circuit. One of them alters the tuning in the ordinary way, and the other switches in different aerial series condensers for each station. The purpose of this is to make it possible to adjust the signal strength from each station to be the same. This has two effects. First, it gets over the difficulty that there is no A.V.C. possible on a synchrodyne. Secondly, it ensures that the strongest signals in the aerial will not overload the R.F. amplifier and produce distortion. It seems a little unusual to begin worrying about the distortion produced by an R.F. amplifier, and one might be forgiven for assuming that R.F. amplifiers do not produce distortion of the signal, for all one hears about this in the ordinary course of events, but in the synchrodyne any source of distortion is very important. The fact is that, the more extended the frequency response of a system, the easier it is to distinguish distortion when it occurs. Added to this is the fact that, normally, the distortion produced by a synchrodyne is very small indeed, so that, once again, we must be quite fussy if the best is to be made of the inherent possibilities of the device.

Another source of possible distortion is the R.F. oscillator, strange to say. Fortunately, distortion from this source is completely absent provided that the locking signal is not too great, but, if it should be, a distorted reproduction of the modulation appears at the oscillator output, and is fed to the demodulator circuit. Again fortunately, distortion arising from either of these causes is quite easy to recognize, because it is very violent in nature, and its onset is very noticeable as the signal is increased from a small value. Should it be encountered, all that is necessary is to decrease the value of the aerial series condenser until the distortion clears up.



DRILLINGS:
A = 3/4" Dia. B = 1/2" Dia. C = 5/16" Dia.
D = 1/4" Dia. E = 1/8" Dia.



ASSEMBLY

OSCILLATOR AND LOCKING CIRCUIT

The oscillator uses a Colpitts circuit, which is excellent for this purpose on account of its level output over the whole broadcast band. It is important that the oscillator voltage should be sufficient at all frequencies within the band, and it should be approximately 1.5 to 2 volts peak, measured across the output winding. The oscillator coil is a dust-cored one intended as the oscillator coil in a normal receiver. One useful feature of the Colpitts oscillator circuit is that it has no tickler winding, so that the one that would normally be the tickler is used instead as an output winding. Using a normal broadcast oscillator coil in this way also has the effect of improving the stability of the oscillator. In its conventional role it would have a tuning capacity of about 420 $\mu\mu$f. maximum capacity, with which it would tune to approximately 1000 kc/sec. or 455 kc/sec. higher than the low end of the broadcast band. This means that, to tune it to 570 kc/sec., the frequency of 2YA, considerably more tuning capacity is needed. This makes it quite a high-C circuit, and results in improved stability, which is very important in this application. As a result of this arrangement, the condensers that must be used are quite large, since the Colpitts circuit has two capacities in series across the coil instead of the more usual one.

It will be noticed that the trimmer condensers have been connected across only half of the tuned circuit. This makes them equivalent to a condenser of only a quarter their size connected right across the tuning coil, and gives a bandspread effect which makes them rather easier to adjust critically. A panel control of oscillator frequency is given by a small trimmer, connected so as to be in circuit on all stations. This acts as a "tweaker," which enables adjustment to be made when the set has just been switched on and has not reached its stable operating temperature. In practice, it has been found that there is very little need to use this control as long as the set has been accurately adjusted in the first place. For example, after the set has been running for several hours, and is thoroughly warm, it has been found possible to switch it off, let it cool down over-night, and turn it on again without having to wait more than a minute for it to come into lock as it warms up again.

The locking signal voltage is applied directly to the grid of the oscillator from a cathode follower buffer valve, which is fed from the plate of the R.F. amplifier. This buffer was found to be essential, for, if an attempt is made to do without it, it is found that adjusting the tuning of the R.F. grid circuit has an effect on the oscillator frequency. This is very undesirable, and makes the thing very difficult to adjust properly, but by putting in the cathode follower, the effect is eliminated, and tuning becomes no more difficult than tuning anything else.

LAY-OUT AND CONSTRUCTION

There is little more that can be said about the circuit itself, and, indeed, one of the most important considerations is the manner in which the set is built, because it is this which finally determines how satisfactory it will be. Careful construction is absolutely essential, as any loose wiring or components can only have an adverse effect on the stability of the oscillator frequency. If frequency instability is allowed to creep in, the synchrodyne becomes quite useless, as it drifts off frequency very easily, and goes out of lock. If it does this, the result is a horrible heterodyne whistle or growl, which no one will put up with for long.

It should not be inferred from these remarks that there is anything difficult about it. Choice of the right

components in itself is a considerable insurance against frequency instability. For example, on no account must compression-type trimmers be used in the oscillator circuit, where stability is important, although there is no reason why they should not be used in tuning the aerial circuit, which is so broad, and has so little effect on the performance, that drift in the capacities does not matter very much. Reference to the under-chassis photograph will show that air-dielectric trimmers, mounted in a row along the back of the chassis, have been used in the oscillator circuit. These are extremely stable, and will hold their adjustment indefinitely. It is important, too, to choose the right kinds of condenser for the fixed ones in the oscillator circuit. Only good-quality mica-dielectric or silvered-mica condensers should be used here if drift is not to be a problem. In order to save room, the oscillator coil is mounted on stiff connecting wires, directly on the back wafer of the switch. The aerial coil is the one in the miniature can on top of the chassis, on the R.F. side of the baffle shield. The detetctor and audio section is on the right of the baffle shield which runs from front to back.

Apart from power supply leads, the only connections between the R.F. amplifier section, oscillator section, and audio section are taken through three holes in the baffle shields. One of these, between the valve sockets, allows the 50 $\mu\mu$f. coupling condenser between the R.F. plate and the cathode follower grid to be mounted directly on the socket pins, so that it projects through the hole, which is large enough to clear the condenser. The second hole, between the R.F. compartment and the demodulator portion has the 5k. resistor mounted through it in similar fashion. The remaining hole, between the oscillator section and the demodulator compartment, takes the two leads from the oscillator output winding to the diode circuit.

The transformer and the whole of the diode circuit are mounted on a piece of paxolin board measuring $2\frac{1}{4}$ in. x $2\frac{3}{4}$ in. Eyelet lugs are riveted to the board in strategic places, and the diodes, the load resistor, and the 0.01 μf. condensers are soldered to these. The board is then mounted at its corners on bolts, and held away from the chassis by nuts threaded down the bolts a suitable distance to enable the parts underneath the board to clear it.

ADJUSTMENT

After wiring up the circuit, all except inserting the fixed oscillator condensers, the tuner is ready for adjustment. An essential preliminary is to put up the aerial on which the synchrodyne has to work permanently. If this is done, the initial adjustment of the aerial series condensers will also be the last. Take the lowest-frequency station first. This will usually be the local YA station. Since the oscillator circuit is a balanced one, each trial of fixed capacity must consist in placing two equal condensers in, one on each side of the Colpitts circuit. At each trial, tune with the trimmer, and see if the heterodyne with the signal is received. If it is, set the panel trimmer at half mesh and leave it there throughout the adjustment process. This must be done, because the aim is to tune in all stations with their own pre-set trimmers, while leaving the panel control severely alone. In this way, the central position of the latter will be made correct for all stations, and after the setting-up is complete, it will not need touching on any station, except as a very fine trimmer. Then, if it does have to be adjusted, the same adjustment should hold for all stations.

It is certainly a somewhat fiddly business finding the correct fixed condensers for the oscillator circuit. The best plan is to have a number of 100 and 50 $\mu\mu$f. condensers ready, and then, starting with a total capacity that is known to be too small, add 100 $\mu\mu$f condensers in pairs until the desired station is brought within range of the trimming condenser. Initially, it does not matter how many condensers are used, for, when the station is found, and can be tuned through zero-beat by the station's trimmer, the total capacity on each side of the oscillator circuit can be totted up, after which it will not be difficult to see how the total capacity can be made up with the smallest number of fixed condensers.

It does not matter where the station's trimmer is set for proper tuning, as long as it is not right at maximum or minimum capacity, thus allowing no adjustment on one side of the zero beat. When the fixed condensers have been chosen for the first station, the next job is to tune the R.F. grid circuit for that station. This is best done in the following way. First, the oscillator is de-tuned slightly so that a fairly high-pitched beat note is heard. The R.F. grid condenser is then adjusted for the maximum loudness of the beat note, indicating that the circuit is tuned for maximum signal. While this is being done, the actual beat note will vary slightly, owing to its trying to bring the oscillator nearer to locking. Take no notice of this effect, however, as all we are using the beat note for is an indication of loudness.

The next step is to adjust the aerial series condenser. This is done by first using a small setting, so that the signal fed into the circuit is quite weak. The oscillator is then tuned carefully until locking takes place. It will be noted that if the signal is weak, the beat note which occurs as the oscillator is tuned in disappears after it has reached quite a low growl. If the beat disappears when the beat note is quite high in pitch, it indicates that the locking signal is quite large. The best way of adjusting the aerial condenser, therefore, is to give it such a value that, when the oscillator is tuned in, the beat disappears at some frequency between 100 and 200 c/sec. At this, locking will be quite positive, and if the set has been well built, there will be no tendency for it to drift out of lock.

It should be remembered that the final adjustment of oscillator frequency should not be made until the set has been running for at least a quarter of an hour, so that the parts will have had a chance to reach their final working temperature. If this is done, and it is then found that, on switching on from cold, quite large readjustments have to be made to keep the set in lock as it warms up, it is a sure indication that one or more of the condensers in the oscillator circuit is not stable enough, and is drifting too much in value as the temperature changes.

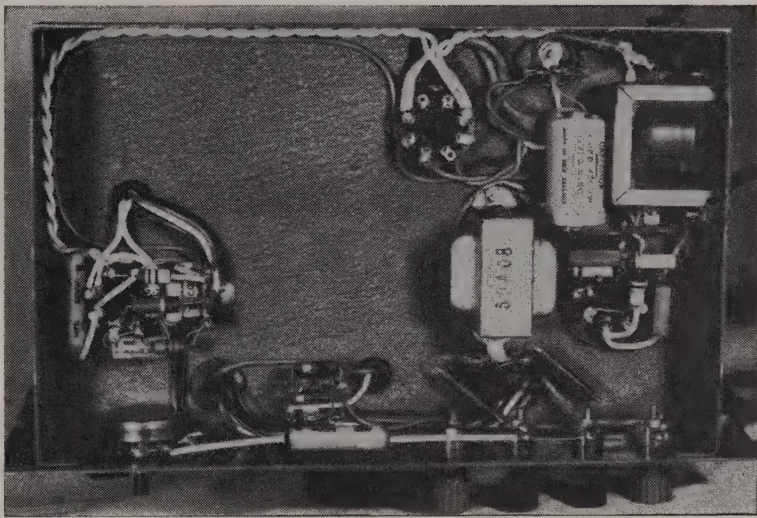
In the circuit diagram, the aerial series condensers have been shown as fixed in value. This makes the construction a little easier, and does not make the adjustment more difficult, because there is no necessity for very fine adjustment of the aerial condensers. Such adjustment as has to be made can be done in steps of 25 or 50 $\mu\mu$f., and if the values are so arranged that the locking on all stations takes place in approximately the same way, as described earlier, the volume from all stations will be about the same, and the lack of A.V.C. will not be noticed. Similarly, there will be little likelihood of causing distortion on any station because of too great a signal input.

Test Equipment

AN EASILY CONSTRUCTED R.C. BRIDGE
PART 2

CHOOSING THE STANDARDS

One of the most important things about the construction of a measuring bridge is the choice of components to act as standards. If the bridge is to be reasonably accurate to start off with, and is to retain this accuracy, it is essential that the standard resistors and condensers should be better than average, both in their accuracy and in their stability. Fortunately, small tolerance high-stability cracked carbon resistors are now available in this country, and for a home-made bridge like this one, standards accurate to 1% are quite good enough. These low-tolerance resistors are available in round-figure values. This is just as well, because the preferred values are rather awkward for purposes like this one. Fifty ohms is probably the lowest value that can be obtained in these resistors, and this may have to be made up from two 100 ohm ones in parallel. The best plan, therefore, is to use these 1% resistors for all the ranges except the lowest one or two. For these, it is not difficult to make up one's own by obtaining some fine gauge resistance wire of Constantan or Advance. These alloys are noted for their low temperature co-efficient of resistance, and are much to be preferred to nichrome, which changes its resistance markedly with rise in temperature. However, nichrome will do well enough for a bridge of this sort. Suppose for a moment that the lowest range for which a carbon resistor can be obtained is the 150 to 1500 ohm one, for which the standard is 500 ohms. For the two lower ranges, 50 and 5 ohm standards will have to be wound. This can be done experimentally, after the other ranges have been installed, and the dial has been calibrated, using the bridge itself to measure the value of the resistor as it is made.



Under-chassis view of the bridge, showing the test and external-standard terminals, and the construction associated with the oscillator and bridge detector units.

CALIBRATION OF THE DIAL

When building a bridge, it is one thing to put the circuit together, but the instrument is not complete until the calibrations have been marked on the dial. Before describing how this can be done, it is worth while considering the different ways in which the main dial can be marked. In the list of ranges given in Table 1, it will be seen that the ranges increase in multiples of ten. One possibility, therefore, is to mark on the scale the actual values given by the lowest range, say, 1.5 ohms to 15 ohms. Then, each position on the R switch can be labelled with a multiplying factor appropriate to the range represented by that position. For instance, the one using the 5 ohm standard would be marked x1, the one using the 50 ohm standard would marked x10, and so on. This system has the advantage that only the one calibrated scale is required, and this makes the bridge easy to read, which is a great convenience when using it.

On the capacity ranges, the multiplying factors could be arranged so as to give the answer in either $\mu\mu$f. of μf. For example, the lower range could be marked x10 $\mu\mu$f., which would make it 15 $\mu\mu$f. to 150 $\mu\mu$f. The next range could be marked x100 $\mu\mu$f., taking readings up to 1500 $\mu\mu$f., which is not difficult to translate mentally to 0.0015 μf., if desired. The next range would then be marked x0.01 μf., and so on.

This is perhaps the best scheme to use, since it has the easiest interpretation. Another method of marking the scale would be to mark it in fractions and multiples of the standard, so that the multiplying factor is then the actual value of the standard. For example, the scale would be marked from 0.3 to 3.0. The centre of the ratio arms would then be marked 1.0. This sort of marking is also very easy to read on the resistance ranges but is a little awkward on the capacity ranges on account of the change-over from $\mu\mu$f. to μf., but this could be got over by marking the multiplying factors x50 $\mu\mu$f., x500 $\mu\mu$f., x0.005 μf., etc. Which method is used is purely one of personal preference. The second one takes a little more working out when the standards are in multiples of 5 rather than multiples of 10.

MAKING THE CALIBRATED SCALE

There are two methods of making the calibrated scale. One of them might be called the practical method, and the other, the theoretical method. If the bridge is built using a highly expensive potentiometer, of great accuracy for the ratio arms, the easiest and best would be the theoretical method, for it is a simple arithmetical process to work out at what point on the scale every mark should be put. The use of the calculating method, however, assumes that the potentiometer is perfectly linear. That is to say, that at every point on it, equal angular movements of the pointer produce equal increments in resistance. This is one of the things that makes accurate bridges so very expensive, because it does not matter in the least how accurate the standard resistors or condensers are, if the potentiometer is not linear, because the measuring accuracy depends as much on this as on the value of the standards.

The practical method depends on inserting in the bridge values of resistance which will give known calibration points, balancing the bridge, and putting the appropriate mark on the scale. This is certainly the best and easiest way of doing the job, provided one can come by an accurate decade resistance box. Those who have access to University or Technical College laboratories will have no difficulty in making use of the decade boxes which they are almost certain to possess, and many readers will be able to use those belonging to firms and organizations for which they work, so we will first of all describe this method. The calibration can be done using any convenient standard, such as the 500 ohm one, and in what follows we will assume that this is the one being used. Now high-quality decade boxes are usually accurate to 0.2 or 0.1%—a factor of five or ten times better than the 1% standard it is proposed to use in the bridge. The first job, therefore, is to use the decade box to find the actual value of the standard resistor which is nominally 500 ohms.

To do this, set the switches in the Open Bridge position, and connect the decade box terminals to those marked "External Standard", and the 1% 500 ohm resistor to the "Test" terminals. Place a temporary scale behind the pointer, fixing it firmly in place with sticky-tape. Then set the decade box to 500 ohms, and balance the bridge with the control in the normal way, making a mark at the place where the pointer indicates balance. Now reverse the connections to the bridge of the decade box and the 500 ohm resistor, and re-balance the bridge. If the two balance-points coincide, then the 500 ohm resistor is exactly that value, within the accuracy of the decade box. If the balance points do not coincide, make a slight alteration in the decade box and try the same process again. By trial and error, a setting can be found for the box resistance that will give the two balance points in exactly the same place. This setting of the decade box is the accurate value of the nominally 500 ohm resistor, and the balance point can be marked 1.0, or 5.0, depending on which type of calibration is to be used. Next, make a list of the calibration marks required, using for a start only the widely spaced ones ranging from 0.3 (or 1.5) or 3.0 (or 15). It will be seen that the only difference between the two kinds of scale marking is that one scale is numerically five times the other. Recommended values for the first markings are 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.2, 2.4, 2.6, 2.8, 3.0. When these have been put in, their spacing will indicate whether it is profitable or not to divide them up further, and if so, to what extent. Intermediate divisions will be desirable, because these ones are rather widely spaced. For example, the first three divisions will represent resistances of 1.5, 2.0, and 2.5 ohms on the lowest scale, and 15, 20, and 25 ohms on the next. From this it can be seen that further divisions are essential if the bridge is to be very useful. If a very large scale is used, more intermediate positions can be marked in than if the scale is small, so it is advisable to make the scale as large as one conveniently can. Where possible, the intermediate divisions should be added which will give readings in steps of 1 ohm on the range which starts at 15 ohms. On the basic scale given above, this means placing divisions at 0.32, 0.34, 0.36, 0.38, 0.42, 0.44, etc. Whether or not this type of scale is to be actually marked on the finished instrument, it is best to perform the calibration using these scale markings, because doing so simplifies the arithmetic. These fractions and multiples have to be multiplied by the actual resistance of the standard in order to find the correct setting for the decade box for each division. Then, when the marks have been

made, the appropriate figures can be written on the scale either by using the basic fractions and multiples, or by multiplying these by 5 in order to get the scale that is direct-reading in ohms on the lowest range. In an exactly similar way, the only additional scale, namely the percentage one, can be calibrated. But be careful of the calculation of the right values at which to set the decade box, and remember that the values which will give a reading of +25% will also give the setting for —20% if reversed in the bridge terminals, and the bridge re-set.

If one is not concerned with getting the utmost in accuracy out of the instrument, standards accurate to 1% can be used for the various resistance ranges, without any check as to whether or not they tally exactly on values which appear on two ranges. For instance, a difference of 1% on the scale that will be obtained is hardly readable, and the overall accuracy of the bridge will be less than this in any case, so that it is a moot point whether it is worth worrying about checks of this sort in any case.

On the lowest capacity range, which is from 15 $\mu\mu$f., to 150 $\mu\mu$f., there will be a constant error equal in value to the stray capacity between the test terminals. If this is less than 15 $\mu\mu$fd., it will not be noticeable when the potentiometer is turned without anything connected to the test terminals, but if the strays amount to more than 15 $\mu\mu$fd., it will be found that under these conditions the bridge will balance, and it will therefore be possible to read the actual value of the stray capacity. Accurate readings of small capacities can then be made by measuring the strays in this way, and then subtracting the value found from the value read with the unknown condenser in place. Actually, the strays are likely to be smaller than 15 $\mu\mu$f., in which case it will not be possible to read them by balancing the bridge with nothing connected to the test terminals. If this turns out to be the case, the best plan is to place a Philips trimmer in the circuit, as shown dotted on S_{2b}. This adds the capacity of the trimmer to the strays, and the trimmer can then be adjusted until with nothing connected externally to the test terminals, the bridge balances exactly on the lowest division of the scale. The minimum capacity in the bridge is then known to be 15 $\mu\mu$fd., and this value can be subtracted from the readings on the lowest range to get the true value of the unknown condenser. It would not be a bad idea, too, to place the trimmer in circuit on the next highest capacity range as well, because at its low-capacity end, the 15 $\mu\mu$fd. would still be an appreciable fraction of the true reading.

CONSTRUCTION

The construction of the instrument is quite well illustrated by the photographs, and the chassis diagram. The potentiometer and the switches are mounted above the chassis, directly on the front panel, while the test and external standard terminals are also on the front panel, but below the level of the chassis. The magic eye indicator is also mounted on the panel in order to make adjustment and reading as easy as possible, but in order that the largest possible scale can be put on the panel, the eye has been displaced to one side. The potentiometer is not driven through a reduction drive, but directly by a large knob. This does not reduce the ease with which the bridge can be adjusted, and avoids the slight amount of backlash that seems to be inherent in the small planetary reduction drives that are so popular and inexpensive. The box used to house the instrument is somewhat larger than necessary for the small amount of circuitry involved, and was used partly because it is a stock commercial item, and partly because the minimum-sized box that could have been made to house the circuit would not have allowed a very large dial to be used.

Loudspeakers

HIGH-QUALITY ELECTROSTATIC SPEAKERS

Recently a simple modification to the old electrostatic principle has resulted in the development of "condenser" speakers for which astonishing claims have been made. This short article describes the new principle of operation and how it may revolutionize the design of high-quality loudspeakers.

INTRODUCTION

It is by now a very well-known statement that in reproducing music, the weakest link in the chain is the loudspeaker. This component is variously stated to produce more distortion than any other element in the system, or even to give more than all the rest of the gear put together! Whether or not this is true (and there seems to be reason for believing that it is) it is fair enough to say that no moving-coil speaker can translate electric currents into sound waves with the fidelity of which amplifiers, for instance, are capable. It is not too difficult these days to make an amplifier with a distortion of only a small fraction of one per cent. at maximum power output. Similarly, the best gramophone pick-ups give a good deal less than one per cent. intermodulation distortion, so that if the speaker is not to be the weakest link in the chain, it too must be very distortion-free. Unfortunately, very few laboratories are equipped to measure loudspeaker distortion, and it is in any event a very difficult thing to measure. As with amplifier distortion, there is no known means of measuring the unpleasantness of a speaker, or anything else, for that matter. Various methods of measurement have been suggested, in attempts to arrive at some sort of single figure that will be a measure of the unpleasantness caused by distortion, but none of them have been completely successful. It is true that some types of intermodulation measurement appear to correlate better with the results of listening tests than do other methods, and it would seem that the measurement of intermodulation products of a speaker might be rather easier to do than measuring single-frequency harmonic distortion.

Fortunately, however, there are various ways in which speaker distortion can be observed and evaluated, even if such evaluation does not amount to measurement.

OBSERVING SPEAKER DISTORTION

Anyone who takes it upon himself to say that one speaker is better than another, therefore, is bound to be asked sooner or later how he judges one speaker as against another, and how he is able to assert that one speaker produces more distortion than another. Perhaps this topic does not properly belong to the present article, but it is a very interesting and important one, for which some slight digression is well worth while for most lovers of recorded music.

In the first place, the best way of evaluating a speaker is to listen to it. This may seem a trifle self-evident, but what we really mean is that the listening must be done in a special way. One can tell at first hearing, for example, whether a speaker is producing much at the extreme high-frequency end of the scale, and whether it sounds "clean" and pleasant, but whether this first judgment is a reliable one depends very much on the experience of the observer, and on how well he knows the material to which he is listening. It is characteristic of most people who attempt to judge speakers that the first thing they will listen for is the extreme ends of the scale, and they will usually play music that is suitable for showing up a speaker in these ranges. Even the most experienced listeners, however, can be taken in if asked to deliver a snap judgment. The real test comes on listening to the speaker for a more or less protracted period. It is only then that what may have impressed at first as good high-note response, shows itself as being distorted. Nor is it good enough to judge a speaker merely on what sort of a fist it makes of some of the excellent special "high-fidelity" recordings that are about today. Many inferior speakers will sound very impressive indeed when reproducing such things as a clash of cymbals and it is only by carefully listening to a wide variety of music that one can really tell how good a speaker is. For example, one speaker the writer was asked to express an opinion on sounded quite good on the sort of organ music that consisted of bass pedal notes with the remainder of the music in the upper registers, with little or nothing at middle frequencies. It was only when some "straight" orchestral music was tried that it was noted that the speaker was "muddy" and distorted in the region between 500 and 1000 c/sec.—a region in which most music has a great deal to say. This speaker certainly could produce extreme high notes, and also the extreme lows, but it was one example of a speaker which did give a weird colouration to instruments like traps, drums, etc.

In general, if a speaker is producing excessive distortion, one will realize the fact after sitting down quietly with some favourite music and listening quietly to it for half an hour or so. In bad cases, listening will become a trial after a very short time, and if persisted in, induces a strong desire to throw the offending unit out of the window! In not-so-bad cases, all will go well for a time, after which a vague uneasiness will assail the listener, informing that things do not sound as nice as he first thought. Then some specific listening will often show what it is about the the sound that he objects to. With really good speakers, it will be possible to listen to them indefinitely without any sign of discomfort or uneasiness.

Now this sounds all very vague, and so in a way it is, but it is none the less true, and although it is a long process, especially when one first tries to listen critically to a speaker, one becomes quite adept at spotting distortion, and the register in which it occurs.

Then there is the business of comparison. Everyone

must at some time or another want to undertake a direct comparison between two speakers, and trying to carry out this aim can be one of the most difficult and frustrating of occupations unless it is done properly. For there is only one proper way of doing it, and that is to arrange for instantaneous switching between the two items being compared. If, for example, one has to take one speaker out of its baffle, and install the other before comparing them, no true comparison is possible. Switching must be instantaneous, so that one can listen to the same passage of music on one speaker immediately after hearing it on the other. Better still, switch over in the middle of a passage, before the orchestration has had time to change to another combination of instruments. By making instantaneous comparisons in this way, using a variety of different types of music or combinations of instruments, it is possible to say which of the two speakers one likes best.

The very best speakers are easily recognizable by the fact that they appear to add no sort of colouration of their own to the music. They do not sound over-brilliant in the treble, for example. It is very easy to induce oneself to believe that a speaker has "better" high-note response than another, when in fact it is producing spurious and distorted high frequencies. It is for this reason that such things as blaring jazz trumpets are not good material on which to judge a speaker. The fact is that with such sounds, we have no true basis of comparison between the real and the recorded sound. Sounds like this are very rich in harmonics and unrelated overtones, very similar in character to some of the tones produced by a distorting amplifier or speaker. It is thus very difficult, if not impossible to tell whether they are being reproduced accurately or not. On the other hand, violins, while they can vary greatly in sound quality from one recording to the next, are much more familiar and there is much less difficulty in evaluating their reproduced sound. One can almost always tell, for example, whether the string tone of an orchestra sounds the way it does because of some peculiarity in the recording or reproduction, or whether its sound is characteristic of the orchestra.

Perhaps the best material on which to judge a speaker is a standard orchestral work that is fairly fully orchestrated. In the first place, the music is likely to be familiar, and secondly, it is very easy to differentiate between a nice clean-sounding speaker and a muddy, distorting one on this type of music. The poor speaker will give a jumble of sound, from which it is difficult or even impossible to sort out individual instruments. The good one, on the other hand, will neither sound nasty, nor obscure instruments that should be easily distinguishable.

In making tests like this, of course, it is essential for every part of the equipment other than the speakers under test to be unexceptionable. And this must in particular apply to the record itself. Finally, the true test of a really good speaker is that **the more one hears it, the better it is liked.**

THE ELECTROSTATIC PRINCIPLE

For a very long time now, the designers of speakers have looked at the electrostatic principle and considered that it might one day produce the answer to all their needs. Fundamentally, the electrostatic speaker consists of a rigid plate, close to which is mounted a very thin diaphragm, which forms with it a condenser. A polarizing voltage is placed between the diaphragm and the back-plate, so that the former is attracted electrostatically to the latter, and upon this direct voltage is super-imposed the A.C. audio signal. The alternating voltage causes corresponding fluctuations in the attractive force between the two, so that the diaphragm vibrates, and sets in vibration the air that is in contact with it. Perhaps the biggest attraction that this system has for the designer is that the diaphragm, unlike that of other speakers, is driven over its whole area, and not just at the centre. It should be possible, the argument goes, to drive the diaphragm at any frequency without its breaking up into areas vibrating in different ways. If this is achieved, there should be little or no tendency for the diaphragm to vibrate in other than the way that corresponds exactly to the waveform of the signal fed into it. This means that there should be no distortion produced, either harmonic or intermodulation!—a very attractive state of affairs if it can be realized in practice.

Unfortunately, however, there is a fly in the ointment, and until recently it was such a large one that the ointment was almost unusable! It is that the electrostatic speaker is an inherently non-linear device when it comes to driving the diaphragm. To see what we mean by this, let us consider the moving coil speaker for a moment. In it, we have a coil of wire situated in a magnetic field of constant strength. We pass current through the wire, and this current produces its own magnetic effect which causes a force to be exerted on the coil, tending to make it move. Now in this system, the force exerted on the coil is exactly proportional to the size of the current that is passed through it, and this is what we mean when we say that it is a **linear** device. The term linear refers to the fact that if we plot a graph connecting force and current, it will be a straight line, indicating exact direct proportion. Of course, this does not mean that we can pass as much current as we like through the voice-coil of the speaker without causing distortion, because we have left out of consideration the suspension, which exerts a counter, or restoring force, and prevents the voice-coil from shooting forcibly out and not coming back! However, the main thing to note is that with the moving coil speaker, the force which moves the diaphragm is a linear function of the current in the voice coil.

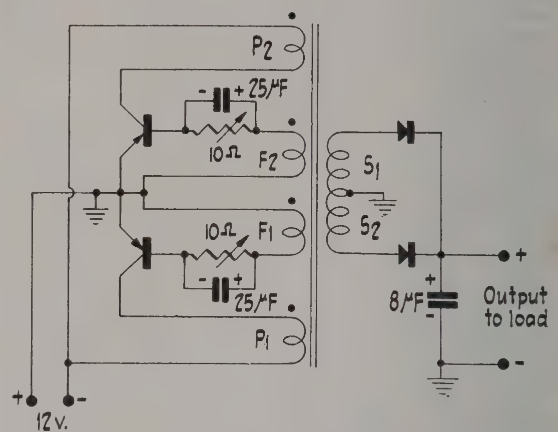
With the electrostatic speaker, on the other hand, the force exerted on the diaphragm is by no means a linear function of the signal voltage. The algebraic expression connecting the voltage between the plates and the force exerted on the diaphragm is a quite horrible-looking one, which includes the **square** of the polarizing voltage, and the square of the signal voltage. It also varies, as might be expected, according to the spacing between the diaphragm and the back plate, and this varies as the diaphragm moves in response to the signal. In the moving coil speaker, the force remains the same, even when the coil does move, provided it stays within the region where the magnetic field is constant. From this, it is only to be expected that an electrostatic speaker would produce very violent distortion, especially if the excitation caused the diaphragm to move very far. Another kind of electrostatic speaker has been thought of, and quite a long time ago too. This was the balanced, or push-pull type, in which the diaphragm is placed between

(Continued on page 31)

The PHILIPS Experimenter

No. 101: The Use of Transistors in D.C. Converters—Part 4

In the last instalment of this series, details were given of several completed designs of converter, for a variety of purposes. Mention was also made of a converter using two Philips transistors, type OC15, in a circuit which gave an output of 12 watts D.C.; at the moment, this is about the maximum D.C. power output that can be obtained with currently available transistors. Space prevented us from giving the circuit of the 12-watt converter, which differs from the others that have been described in employing a push-pull arrangement. This circuit is given here in amplification of the details given in the last instalment. The transformer details have been given for an output of 225 volts at 54 ma., which make the unit suitable for powering a car radio receiver, provided that suitable hash filtering is provided, as in the unit described in the last instalment. The great advantage of a transistor power supply in a car receiver is its virtually unlimited life, allied to its high efficiency and compact form. Also, although hash filtering is required because of the high-order harmonics of the transistor square-wave oscillator, this filtering should normally be considerably easier to accomplish than when a vibrator is employed, as there is no contact sparking to be suppressed.



Circuit of the high-powered converter described in the text. No hash-filtering arrangements are shown, but these could be built as for the unit illustrated in the last instalment.

CONSTRUCTIONAL DETAILS

For those who may wish to try building a 12-watt converter for themselves, the following constructional details may be of interest.

The heart of the device is the transformer. This is wound on a Philips Ferroxcube core, type D36/22-10.00, made from Ferroxcube 3B3. The last figure in the designation gives the length of the inside core, which in this case is the full length of the pot, leaving no air gap when the pot is assembled. The reason for using a full-length centre core is that it is best to leave a gap between not only the centre leg and the top plate, but also between the outside ring and the top plate. Thus, the correct gap can be arranged simply by inserting a spacer of the correct thickness under the top plate. One great advantage of this arrangement is that, should it be found necessary to alter the gap, it can be done by changing the thickness of the spacer. If the gap is left in the centre leg only, the only way is to grind off the core to increase the gap, or substitute a longer piece, to decrease the gap.

For a converter giving 54 ma. at 225 volts, the winding data are as follows:—

Primary: 19 + 19 turns of 28-gauge enamelled copper.

Feedback: 5 + 5 turns of 28-gauge enamelled copper.

Secondary: 377 + 377 turns of 38-gauge enamelled copper.

As in the single-ended arrangement, the primary winding is the one in the collector circuit, while the base winding is the feedback winding. These wire sizes are about the maximum that can be used, but it is good practice to fill the bobbin as much as possible in order to avoid unnecessary copper losses.

It has been found that no special precautions are necessary in arranging the windings on the bobbin. Each primary winding takes up more than one layer on the bobbin, so that the procedure for winding was to put on the first primary of just over one and a half layers. This leaves the remaining portion of the second layer in which to put the feedback winding that is associated with the primary. This done, a layer of insulation is put on, and the second primary and feedback windings are put on in exactly similar fashion. After another layer of insulation, the centre-tapped secondary is put on. No attempt was made to obtain accurate balance of the halves of the secondary. The first half was put on, using the whole length of the bobbin, then, after bringing out the centre-tap, the remaining half was put on.

The oscillation frequency will be found quite close to 5,000 c/sec., and a satisfactory way of adjusting the air-gap in the core is to set up the circuit, get it working on load with a gap that is estimated to be close to the required figure of 0.008 inches, and then to measure the frequency. If this is high, the gap should be decreased, and vice versa.

The rectifiers used in the experimental work were selenium ones, rated at 250 volts R.M.S. input, with

a maximum output of 85 ma. In this application, the peak voltage on the rectifiers will not be as great as the 350-odd volts that will be applied to it by a 250v. R.M.S. sine-wave, so that the rectifiers are operated well within their ratings. When the base resistors have been adjusted according to the procedure given in the last instalment, the input from a 12-volt battery was measured as 1.48 amps at 12.5 volts. This is 18½ watts, and gives an efficiency of 64.6 per cent. It was not possible to substitute a number of OC15 transistors in the circuit at the time when the experimental work was done, but it seems likely that some transistor pairs would give even higher efficiency than this.

One desirable characteristic of this circuit was that as the load was reduced, there was little change in the output voltage, only the input and output currents changing. At the same time, it was noted that, as the loading was decreased, so the efficiency became greater. This is very useful for a supply which is powering a radio receiver, because it means that when a strong signal is being received, and the H.T. current is reduced by A.V.C. action, so the benefit of the reduced drain is passed on to the battery. Also, with good regulation, it should be possible to use a Class AB or even a Class B output stage in the receiver. This would mean a considerable saving in battery drain, and would make available a larger maximum power output—a very desirable state of affairs for a car radio.

A converter with this output capability could have many uses other than merely working a car radio. It would be ideal for portable instruments that have a fairly high H.T. requirement, and it would be more than sufficient for powering a walkie-talkie type of two-way radio communication set, especially one that used a small 12-volt accumulator as the primary source of power.

CONVERTERS FOR SPECIAL PURPOSES

For some purposes, special tricks have to be resorted to in order to facilitate the design of the converter. One fairly obvious case is the one in which very high output voltages are required, as, for example, when several kilovolts are needed for exciting a cathode ray tube in a portable instrument. For supplies of this nature, it is usually advantageous to use a voltage-multiplying rectifier system rather than to attempt to design the converter to produce the required voltage directly from a half-wave rectifier. The reason for this is that for very high step-up ratios, the available winding space on the bobbin can become a limiting factor in the design. Also, since the Ferroxcube pot cores are so compact, insulation in the case of high output voltages becomes a problem, because adequate insulation can easily take up a disproportionate fraction of the total winding space. Another reason for avoiding transformers with very high step-up ratios is that it becomes difficult, again because of the small winding space, to employ a style of winding which minimizes self-capacity in the secondary winding. If this capacity is too large, the transitions in the transistor switching cycle take too long, with the result that the transistor's transient losses become too high, and the overall efficiency drops. On balance, therefore, it is often an advantage to accept the reduced rectification efficiency of a voltage-multiplier circuit in the interests of reducing the transistor losses.

If a few examples of converter design are worked out, it soon becomes apparent that, even when the output voltage is low, the same difficulties as have been described in the preceding paragraph crop up if the output impedance becomes very high. That is to say, if the load current is very small. A useful example of this is the powering of a valve hearing-aid amplifier by a converter in order to abolish the B battery. Such a converter might have an output of 30 volts at 250 μamps. Now the power delivered is only 7½ milliwatts, and this is well within the switching capability of a Philips OC71 transistor—the same type as is used for the power output stage in transistor hearing-aid circuits. It is also possible to use one of the smallest pot cores—namely, the D14/8, which is just slightly more than half an inch in diameter, without danger of saturation.

Working out the design on the basis of an operating frequency of 6,500 c/sec., one arrives at a primary winding of 138 turns, a feedback winding of 16 turns, and a secondary winding of 1140 turns. This is a very large number to accommodate on the minute bobbin of a D14/8 core, unless exceedingly fine wire is used. From this, it can easily be seen how the number of turns of wire can limit the design rather than electrical or magnetic considerations. Incidentally, this example was worked out on the basis of a 4½-volt battery, and if a 3-volt or 1½-volt battery had been stipulated, the total turns would be rather greater.

For the very low-powered converters, where efficiency is of little importance, it is often of advantage to raise the operating frequency in spite of the increase in the transient losses. This also has the effect of decreasing the number of turns required on the bobbin, because, for a given output power, the numbers of turns on all three windings is inversely proportional to the square root of the frequency. That is to say, increasing the frequency by a factor of 2 multiplies the required number of turns by a factor of 0.707, or multiplying the frequency by four makes the required turns only a half of those calculated for the lower frequency.

Another interesting point in connection with the design of converters is that, for a given output power and input voltage, the required peak primary current remains constant, irrespective of working frequency. This means that, where a design is limited by the peak collector current of the transistor it is proposed to use, altering the frequency will not have any effect on the transistor dissipation, nor on the peak collector current.

EFFECT OF VARYING THE INPUT VOLTAGE

In designing power converters, there may sometimes be some choice of battery voltage available, so that it is useful to know how changing the input voltage affects the converter itself. The main effect is that lowering the input voltage increases the peak collector current, and the maximum peak collector current rating of the transistor may therefore become the limiting factor when a low battery voltage is desired. Owing to the fact that there is a small voltage drop across the transistor, the actual voltage operating in the primary circuit is always slightly less than the battery voltage. The voltage dropped in the transistor is only a fraction of a volt, so that when the battery voltage is six volts or higher, one can assume with little error that the peak collector current will be inversely proportional to the battery voltage.

At lower voltages, however, the drop cannot be ignored, as the following example will show. Suppose the transistor drop is 0.2 volts. Then, with a 3-volt battery, the effective primary voltage would be 2.8.

If it were desired to work instead from a 1½-volt battery the effective primary voltage would be 1.3. Now the peak collector current in this case would not be twice that of the 3-volt one, but the increase would be in the ratio of 2.8 to 1.3, or 2.15, or 7½ per cent. more than one would calculate from the battery voltage.

Another important effect of lowering the battery voltage is to increase the step-up ratio of the transformer, thus causing an increase in the number of turns on the bobbin. The effect can be used when taken in reverse to enable a smaller core to be used than would otherwise be possible. In general, then, from all points of view, it pays to work from as high a battery voltage as possible.

TRANSFORMER CORE MATERIAL

It will have been noticed that all the examples that have been given in this series of articles have shown the use of Ferroxcube pot cores. It does not follow, however, that these always give the best results. Indeed, in high-powered circuits, iron-cored transformers can be preferable. Their main advantage over Ferroxcube lies in the much higher saturation flux, which allows a given primary inductance to be obtained with only a small number of turns. This makes it possible to use low working frequencies without having high copper losses, while a low frequency will also minimize the transient losses. Thus, for high-powered converters, iron cores can give higher overall efficiency. This advantage is somewhat offset, however, because of the greater difficulty of smoothing the output when the frequency is low, and also by the higher cost of suitable iron cores.

IMPORTANT NOTE.—The OC15 is a provisional type, and supplies are not assured in the meantime. In this Experimenter, the use of OC15 is purely illustrative of the possibilities when this type or its counterpart becomes freely available.

N.Z.A.R.T. NOTES

(Supplied by the Publicity Committee, N.Z.A.R.T., 25 Lees Road, Christchurch, to whom all inquiries should be addressed.)

In this contribution we digress a little from the usual fare to bring you a brief account of an interview with Major Owen Perry, W3NOT, Chief Communication Technician with Operation "Deep Freeze". Presenting an overall picture of what might be expected on the Ham bands from the South, and drawing attention to several unusual points, Owen told us that the calls of the stations down South will be KC4 USA, at Little America, KC4 USV, at McMurdo Sound; KC4 USB at Byrdland; and KC4 USN at the Geographical South Pole. The first station on the air will be that at Little America, and operation is anticipated from here early this month. Operation from the others will follow as the camps are established, and the last station to come on, that at the Pole, will be sometime in December of this year.

Amateur radio, of course, is regarded as a recreational facility, and, as such, will be the last thing to be installed and hooked up. No regular operational times are available, as transmissions will have to be fitted in with the real purpose of the Expedition which will call for hourly readings in many of the sciences. At present there is no information of the possible frequencies, but it is anticipated that 20 metres would be a possibility, as this band was quite good when the Byrd Expedition was down there in 1948. Most of the men who will be operating are not amateurs, though they are experienced in radio communication. Therefore, they are likely to take some time to get into the swing of amateur operating, and, naturally, will be directing the majority of their time towards the States until the lure of DX catches them. During the time they are concentrating their efforts on the United States, we specially request that they be left to it. After all, the U.S.A. is their homeland, and their thoughts will be there until such time as the homesickness wears off. As they are to be in the Antarctic for a long period, there will be plenty of time for all to contact them later.

Probably they will use fixed, widespaced beams directed Stateside for some time, but, as the DX bug bites, it is anticipated that they will erect some aerial of the non-directive type. A rotary beam will be out of the question, as it would be impossible to build one able to withstand the wind velocities of up to 100 miles per hour experienced there. The transmitters to be used are of the Collins KWS 1 type, capable of one kilowatt on single sideband and CW with a nomainal six hundred watts on AM phone. An interesting point is that the snow on the Polar Ice Cap, being formed from distilled water and thus free from contamination is a perfect insulator. Thus, it is possible to have the ideal situation of a transmitter hooked to an antenna lying on the snow, and we have the transmitter and its aerial some three hundred feet above the effective earth level.

Finally, with regard to the QSL situation, as physical communication with the operation will be very intermittent, it will be some time before the coveted cards begin to appear in the rest of the world. Be patient, because there is nothing you can do about it anyway. Furthermore, if you hear the boys down there on the air, give them a fair deal; respect their directional calls and do not, under any circumstances, net to their frequency.

The British Institution of Radio Engineers

WELLINGTON SUB-BRANCH

The first two lectures for 1956 to be arranged by the Wellington Sub-section of the British Institution of Radio Engineers are as follows:—

12th March, 1956:

Lecture Room, Civil Aviation Administration, Bunny Street, Wellington—5.30 p.m.

Speaker: Mr. N. B. Johnston, A.M.I.E.E., New Zealand Broadcasting Service.

Subject: THE ACOUSTIC PROPERTIES OF SOME NEW BROADCASTING STUDIOS.

A changed approach to the acoustic treatment of small and medium-sized studios will be described, together with the results of acoustic measurements made at various stages during construction. Some general conclusions on the use of different absorbent materials will be drawn, and the equipment used for the measurements described.

9th April, 1956:

Lecture Room, Civil Aviation Administration, Bunny Street, Wellington—5.30 p.m.

Speaker: Mr. G. W. G. Court, B.Sc., A.M.I.E.E., A.Inst.P., Civil Aviation Administration.

Subject: THE RADAR TECHNIQUES FOR MOVING TARGET INDICATION.

The lecture will deal with the techniques adopted in modern radar equipment to give a display free from clutter due to reflections from hills, buildings, etc.

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High-quality Electrostatic Speakers

(Continued from page 27)

two perforated metal plates. This time, the polarizing voltage is applied to the diaphragm itself, and the signal voltage is applied in push-pull to the two outer plates. This was done on the principle that the push-pull arrangement should get rid of the second harmonic type of distortion that is inherent in the unbalanced version, but unfortunately, the new arrangement is also far from linear, although it is somewhat better than the first.

At this stage, the reader might well ask how it is that electrostatic speakers have been on the market, and quite recently too, if their distortion is so high? The answer is simply that by reducing the allowable diaphragm movement to very small proportions, the essential non-linearity can be minimized, because it shows up worst at large movements. One way of doing this is to make no attempt to reproduce low or even medium frequencies with it, thus making it purely a tweeter. Up till now, electrostatic tweeters have been the only satisfactory application of the electrostatic principle to loudspeakers.

The fundamental cause of the non-linearity of the electrostatic speaker is the fact that the force exerted on the diaphragm is proportional to the square of the signal voltage. It can easily be proved that the force is equal to $\frac{1}{2}QV/d$, where Q is the charge on the condenser formed by the two plates, V is the voltage between them, and d is the distance between them. But $Q = C.V$, where C is the capacity of the condenser. Substituting in the first expression, we get: $F = \frac{1}{2}CV^2/d$. This shows that if the charge Q could be kept constant, instead of varying as the signal voltage changes, the non-linearity would disappear.

THE NEW PRINCIPLE

Before we see how this can be brought about, let us first of all see what happens when the old type of electrostatic speaker works. Let us suppose that the signal voltage for the time being adds to the polarizing voltage, causing the diaphragm to be attracted more closely to the fixed plate. As the diaphragm moves, the capacity increases. The voltage between the two has also increased, so that the charge on the condenser has risen from $Q = C.V.$ to $Q' = C'V'$. The additional electricity stored in the capacity of the condenser must have flowed in from the polarizing battery. Similarly, when the diaphragm moves away from the fixed plate, the charge is reduced, and this can only come about by a current flowing in the reverse direction, back into the polarizing battery.

One possible way of keeping the charge on the condenser constant would be to charge up the diaphragm, and then isolate it electrically, so that it would then be perfectly insulated from everything else. The law of the device would then be a linear one, and the diaphragm movement could be as large as we please without introducing distortion. Unfortunately, however, the charge would leak off after a time, however well insulated the diaphragm might be, so that this solution, while theoretically sound, would be impracticable. But if, instead of isolating the diaphragm completely, we isolate it partially, by placing a very high resistance in series with the source of polarizing voltage, we can get exactly the same effect, provided we do not want the speaker to work at frequencies that are too low. In other words, if we make the resistance so high that the time-constant CR of the polarizing circuit is always very great compared with one half cycle at the lowest frequency we wish to reproduce, the diaphragm will act as though it were completely isolated after having been charged up, and we will have achieved in practice the conditions that are needed to make the speaker a linear one over the frequency range that is of interest.

This principle has been used in several experimental electrostatic speakers that have been constructed by Messrs. P. J. Walker, of the Acoustical Manufacturing Co., and D. T. N. Williamson, of Ferranti Ltd., whose firms are collaborating on the development of these speakers. Measurements made by them support the theory that very small distortion can indeed be achieved, and it is claimed that figures approaching those obtained from the best amplifiers have been recorded. If this is so, there will be a very drastic change in the existing situation, for no longer will the loudspeaker be the weakest link in the chain. However, it will probably be some time before these speakers are available commercially, and in the meantime, we have available some very fine electromagnetic speakers. But if the new speakers come up to expectations, the effect upon sound reproduction should be very easily noticeable, and we will obtain a realism that is difficult, if not impossible to achieve today.

THE "R. & E." HIGH-QUALITY NINE

Some Further Points

There are one or two points about the above receiver that did not appear until a little experience had been gained in operating it, and we take this opportunity of bringing them to the attention of those who might be building it, or who intend to do so. The first point concerns the addition of a 100 $\mu\mu$f. condenser in parallel with the aerial winding. Without this condenser there is a tendency to instability at the extreme low-frequency end of the dial, owing to the fact that, with a short aerial, the primary of the aerial coil resonates rather too close to the low-frequency end of the band for comfort. One other effect may also be noticed if this condenser is omitted—namely, a rather bad repeat point of 2YA, at or near 620 kc/sec. Both these effects are eliminated by the use of the condenser.

USE OF COMMERCIAL BAND-EXPANDING I.F. TRANSFORMERS

In Part 2 of this article, we mentioned that if one did not want to put one's own tertiary windings on standard I.F. transformers, it would be possible to use commercially built transformers of this kind. However, with the exact circuit given for this set, there is one difficulty. It will be noticed that in the transformers used in our circuit, both have the tertiary winding connected in series with the secondary. The maker of the commercial transformers has written and pointed out to us that his transformers are not identical, one being intended for use following the mixer valve, and the other being meant for coupling between the I.F. amplifier and the detector diode. The latter transformer has the tertiary winding in series with the primary, while the first transformer has it, as we have, in the secondary circuit. Thus, if the commercial transformers are used, the switch must be moved to its primary, as is shown in the circuit provided by the maker with each pair of transformers. In all other respects, the circuit can remain unchanged, except, of course, that the missing connection, mentioned in the second instalment of the article, must still be restored. Before leaving this topic, it should be mentioned that the commercial band-expanding transformers will not give the bandwidth that the hand-modified ones will, and those wanting the greatest possible bandwidth should be prepared to wind their own tertiaries.

A better solution than modifying the circuit, when the commercial I.F. transformers are to be used, is to use two of the inter-stage type, instead of one inter-stage and one diode transformer. If this is done, the circuit can remain exactly as is.

TOP CAPACITY COUPLING IN THE R.F. SECTION

The aerial and R.F. coils that are commercially available, and which were used in the prototype set are sold together with small ceramic condensers that are intended to be used by connecting them from the "hot" end of the primary to the grid end of the tuned winding. This applies to both the aerial and R.F. transformers. However, it was found with the prototype that, with the top capacity coupling applied to the aerial coil, there was difficulty in getting the aerial circuit to track properly, as it caused the aerial trimmer to peak almost at minimum capacity. Removing the coupling condenser from the aerial coil eliminated this effect. The top capacity coupling was left in the R.F. coil, because it caused no such effect, and because it does help to equalize the gain over the band.

BOOK REVIEWS

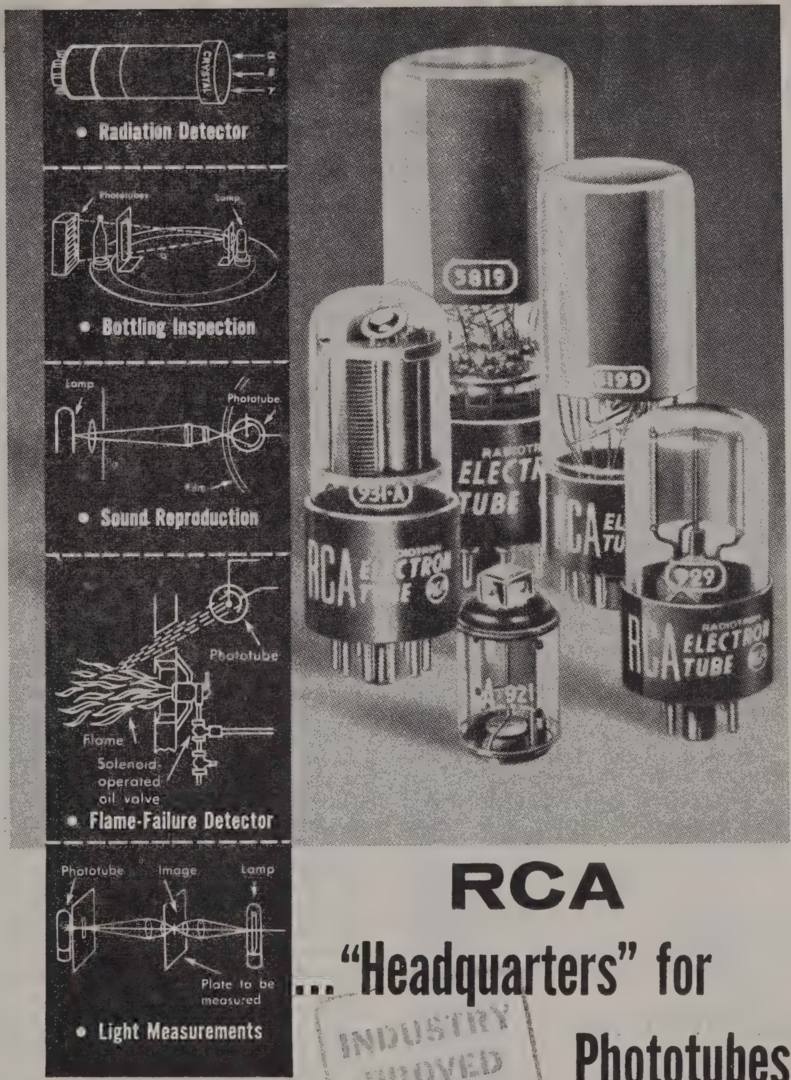
Basic Synchros and Servomechanisms, by Van Valkenburgh. Nooger & Neville, Inc. Published by John F. Rider Inc., New York.

This work is in two volumes. Volume 1 covers synchro fundamentals, synchro generators and motors, differential motors, control transformers, and fundamentals of servomechanisms. Volume 2 goes into detail about the component parts of servomechanisms, and covers error detectors, servomotors and amplifiers, thyratons, and control circuits, Ward-Leonard and amplidyne control systems, anti-hunt arrangements, and two-speed systems.

The text is stated in the preface to be the material of a U.S. Navy course on these matters, as taught to technicians who have to deal with radar, gun-laying systems, and other automatically controlled devices which make use of servomechanisms. It is entirely non-mathematical, and uses a most effective picture-book technique for introducing the many new ideas that are involved in the subject. The book is obviously not intended for instruction at other than technician level, but its presentation of a difficult subject is so clear and concise that it can well be recommended as an introduction to the subject for even the most erudite of those who are tackling it for the first time. The present reviewer has seen a great many text-books in the last few years, but he has never before seen anything like this. What the Americans know as "synchros," and the British by other names such as "selsyns" or "magslips," are described in terms of simple A.C. theory, and with a wealth of large, clear diagrams illustrating their operation in step-by-step fashion.

All the common variations are described in turn, and their different design and application are stressed throughout. Volume 1 ends with an exposition of the fundamental purpose and principles of servomechanisms. This section of the book is very well done indeed, the treatment being built round the hypothetical case of a servomechanism designed for automatically holding a ship to a given compass course. A simple arrangement is built up from first principles, consisting of a pair of potentiometers as the control and error-detection devices. These in turn are imagined as driving a steering motor in the appropriate

(Continued from page 34)



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Dry Battery Technotes

NO. 7: BATTERY REPLACEMENT IN PORTABLE RECEIVERS

One quite often hears comments from those who have bought battery-operated portable sets that they are too expensive to run, because the batteries have to be replaced too frequently, and we are convinced that this belief has had a considerable, and adverse effect on the popularity of such receivers.

Unfortunately, perhaps, battery sets are a little like cars, in that if the user is to get the best out of them, he needs to know a little about them. This does not mean that one should take a short course in radio technology, but simply that a few simple pieces of knowledge will certainly help him to obtain the best usage from the batteries.

In the first place, most battery sets have separate batteries, called the A and B batteries respectively. The A battery has the job of heating the filaments of the valves, and in sets which do not provide alternative operation from the mains, it usually comprises a single large 1½ volt cell, or sometimes, a number of smaller 1½ volt cells connected in parallel. The B battery comprises one or more blocks consisting of many cells in series, making up total voltages of 45, 67½, or 90, depending on the design of the set. Now the B, or high-voltage battery is essential to the working of the valves, but they will not work properly however good the B battery, if the A battery is run down. Similarly, if the A battery is new, but the B battery is run down, the set will still not function as it should. Now most makers of battery sets take pains to arrange things so that when the set is in normal use, the two batteries run down at approximately the same rate, so that when one is run down, so is the other. To the user, this means that when the set's reception falls off, owing to the running down of the batteries, both A and B batteries need replacement at the same time. Some sets, however, are not like this, and the batteries do not run down at the same rate. If the user is not aware of this, he is likely to go off and buy a complete set of batteries, not realizing that by replacing A and B together, he is wasting many hours of useful life by discarding one of them before it is really finished. Of course, not many people have their own facilities for testing batteries, but any radio dealer can do this, and can recommend which battery needs replacement. When having batteries tested, do not take them out of the set, but take the whole set in. The reason for this is that their true condition can be found only when they are connected to the set, and the latter is switched on. If a B battery is near the end of its useful life and has not been used for a long time, it may quite easily read as good when tested out of the set, but when connected and attempting to work, its voltage may be much lower, indicating that it has "had it".

If the batteries have recently been replaced, and the set exhibits symptoms indicative of run-down batteries, most users will immediately conclude that the new batteries were "no good", and will malign the battery maker or seller accordingly, but the fact is that many faults that can occur in battery sets cause the batteries to become prematurely discharged. The only way to cure the trouble is thus to find and fix the fault in the set. It is most important therefore, if batteries are suspected of having lasted badly compared with the previous set, that it be taken to a competent radio serviceman. If he checks the set and finds nothing wrong, well and good, but if he finds a fault and rectifies it, the cost of having the set fixed will frequently be much less than that of persisting to feed new batteries to a faulty set!

Book Reviews

(Continued from page 32)

direction to correct an error that develops in the system. From this impracticable but theoretically feasible device, the scheme is developed to include all the elements of a practical steering servo, illustrating in the process many of the machines whose principles were outlined in the earlier chapters. This approach is typical of the whole work, of which Vol. 2 treats the detailed component parts of practical servomechanisms of various kinds.

Industrial electronics is a branch of activity that is coming rapidly to the fore in many places, and the theory and practice of servomechanisms the very bread and butter of what has recently been labelled "automation." Any radio technician who has a mind to learn something over and above his present field would be well advised to read these two books; it does not take much of a prophet to foresee that their contents will soon figure even more extensively in modern industrial equipment than they do in military applications at the present time.

WHY COLOUR TELEVISION IS NOT YET A SUCCESS IN AMERICA

D. C. Birkinshaw's Address to the Television Society

(Reprinted by Courtesy of "Wireless and Electrical Trader," Dorset House, Stamford Street, London, S.E.1.)

The reason for the lack of interest shown in America in the colour television transmissions which commenced about a year ago but have not been taken up either by advertisers or the public lay principally in weaknesses in the receiver, according to D. C. Birkinshaw, superintendent engineer of B.B.C. Television. The colour television service had been launched prematurely, before receiver design had reached the stage where colour receivers could be made that were suitable for general use in the home.

Mr. Birkinshaw, who visited America early in 1955 to investigate the status of colour TV on behalf of the B.B.C., was addressing a packed meeting of the Television Society, and he attributed the failure of colour TV to the following six reasons:—

(1) The cost of receivers was too high, ranging from 795 to 890 dollars, as against 170 to 400 dollars for monochrome (black and white receivers).

(2) The aesthetic value of colour had less appeal than had been hoped for. Apart from its novelty, the advantage of colour was not very great.

(3) At present, at least, there were too few transmissions. He was given every assistance by the N.B.C. and supplied with a receiver, but in five weeks he saw only five hours' colour transmissions.

SIZE OF PICTURES

(4) The pictures were too small, by American standards at least. He saw 12 in. and 15 in. models which were all that were available then, but if a larger monochrome receiver were working in the same room, it distracted attention from the smaller colour picture, which looked insignificant beside it.

(5) The cost of transmission was very high, amounting to something like 165,000 dollars for a one-hour programme.

(6) There existed the possibility that the N.T.S.C. system itself is not adequate. Mr. Birkenshaw quoted this item with some reluctance, and said that he hoped that the system itself was not at fault. The tests now being undertaken by the B.B.C. would clear up that point, but, in any case, he felt great sympathy and admiration for all the people concerned who had put so much effort and money into the development of the system.

A further adverse factor that was not included would be the cost of maintenance, but that did not yet arise because the public had not had any experience of it. Two of the company's colour engineers spent eleven hours adjusting the receiver on which he viewed the programmes, but the quality of the pictures, and their colour rendering, was not good.

The C.R. tubes did not give true colour rendering owing to poor registration, which was affected, amongst other things, by the earth's magnetic field. Whites were tinged with colour, and so were blacks, but a monochrome picture seen on a colour receiver showed much better quality than in current U.S. monochrome receivers, whose standard of quality was very poor. In the cities, the poor definition of monochrome receivers was accompanied by reflections (which kept changing) and interference, and sometimes it was difficult to recognize the picture.

LIGHTING PROBLEMS

Studio lighting alone was a serious factor in the cost of transmission, the studio being stacked with as many lighting units as could be crammed into the available space. The average consumption was 150W. per square foot, and in one large studio, the total lighting load was 1,250 kW (1.24 megawatts). Very elaborate lighting control arrangements included massive telephone switchboard type plug-in boards carrying kilowatts per plug, and large gantries carrying banks of lamps that can be raised and lowered electrically, singly or in mass.

RECORD TALK

by JOHN GRAY

By a process of changing ownership such as we often encounter in the business world, one or two well known makes of records are now to appear under different auspices. The New Zealand firm of H.M.V. have acquired the Capitol catalogue, but have in turn relinquished the local rights to American Decca whilst retaining English Decca (a totally different firm). American Decca has such aces as Bing Crosby, Danny Kaye, and Guy Lombardo on its roster, and this desirable catalogue is now being marketed under the Festival label. There have been speculations concerning the future of American Columbia, which has been handled here by the local branch of the giant Philips company. We should soon know what local distribution has been arranged. Meanwhile H.M.V. have announced their first Capitol release, and are up to date with such attractions as the cautionary ditty "Black Denim Trousers and Motor Cycle Boots", a song about a speed merchant who came to a violent end. This tale is told vigorously by the Cheers, and coupled with "Some Time in Alaska" on 3219 (the numbers of these new Capitol issues have no prefixes). Joe "Fingers" Carr is still happily punching his piano on 3152 with "Let Me Be Your Honey, Honey" and "Ragtime Cowboy Joe"; and Stan Freberg, from whom we have heard less of late, is back on form with his own version of "The Yellow Rose of Texas" and "Rock Around Stephen Foster" (3249). Tennessee Ernie Ford's "Sixteen Tons" (3262) is the first major hit to be issued under the new Capitol regime. Radio Corporation have said their regretful farewell to this popular line in the release of another Joe "Fingers" Carr coupling, "The Barky Roll Stomp", which turns out to be Offenbach's best known piece suitably hotted up, and which shares CP 442 with an old stager, "Deep in the Heart of Texas". Jane Froman's hit parader "I Wonder" is issued on CP 437 backed by "I'll Never Be The Same", and the last of a great procession of Nat King Cole's releases from this source appears with "Autumn Leaves" and "Love is a Many Splendoured Thing" (CP 445). The firm will presumably concentrate on their Tanza releases until it is definitely known which overseas line they will be marketing here. Meanwhile they have "Sixteen Tons" and "Only You" as done by Auckland's Stardusters on Z 263, and another Bill Wolfgramm-Daphne Walker effort with a strong local slant (Z 262)—the numbers are "Kotuku" and "Maori Action Song". I hear that a Walker-Wolfgramm LP will soon grace Tanza's catalogue.

Festival are keeping grimly and optimistically to the 45 speed for their pop releases, the up and coming "Ain't It a Shame" and the already well known "Seventeen" being coupled by Jim Brown and Sy Oliver's Orchestra on XP 45-773. They have combined Tony Russo's singing of "Stranger in Paradise" with Tex Stewart's of "Davy Crockett" on XP 45-755, and their version of the "Yellow Rose" joins "You Are My Sunshine" in a performance by the Bell Ringers on XP 45-760. Festival had the happy idea of arranging a recording session with Sybil Thorndike and Lewis Casson whilst the distinguished pair were in Australia, and the result appears on CFR10-749. There are some unusual items here, ranging from an excerpt from "King Henry VIII" to a poem by their son, John Casson. On the classical side, Festival have an authentically "Northern" performance of the Sibelius first symphony by the Stockholm Philharmonic Orchestra on CFR12-177, and, in their Vox series, the magnificently romantic piano concerto No. 4 by Anton Rubinstein, with the Austrian virtuoso Friedrich Wuhrer as soloist (PL 7780). This is the heyday of the romantic concerto, as seen by the phenomenal record sales of Grieg, Tchaikovsky, and Rachmaninoff. I should point out that the Rubinstein concerto belongs definitely in this company and will disappoint no one who tries it. A fine performance of Mahler's first symphony is conducted by Jascha Horenstein on PL 8050. This is one of the most enjoyable and impressive of the late nineteenth century symphonies, and first appeared in 1888, the year of Tchaikovsky's fifth.

The newest Radiola Telefunken releases cater once again for those who enjoy Continental music. Among the 78 rpm selections are excerpts from such melodious operettas as "Clivia" and "The Flower of Hawaii" on EO88T and EO89T respectively, and other issues include vocal potpourris from the better known "Countess Maritza" and "Gypsy Princess". On LP a number of children's choirs have combined for our entertainment, the lineup including the Vienna Boys' Choir (LA 6087). A Spanish suite by Albeniz is played by a Madrid Orchestra under Juan Olmedo on NLB 6089, and there are good performances of Bach's first and third orchestral suites by the Berlin Chamber Orchestra under Hans von Benda on LE 6525.

Mercury have brought out an LP by the popular "Crew Cuts" who, by the way, have recently made wildly applauded appearances in several English variety theatres. Called "Crew Cuts on the Campus" the new disc features vigorous treatment of several college favourites (MG 25200). On MG 25057 we have "Immortal Songs for the Home", a group of standard favourites such as "Because", "At Dawning", and "A Perfect Day", sympathetically rendered by a number of singers, including our old friend John Brownlee. The pop singles recently issued include Eddy Howard's version of "The Man from Laramie" (M 4161) and a new issue by the irrepressible Georgia Gibbs who gives "I Want You to be My Baby" and "Come Rain or Come Shine" on M 4145. Ralph Marterie has a distinctive new tune in "The Toy Tiger" which shares M 4144 with "Mabellene".

From Philips come the usual crop of light LPs, with such surefire sellers as Geraldo's "Tango Time" (BBR 8005) and a recording of Marlene Dietrich taken from one of her appearances at the Cafe de Paris (BBR 8006) and on which you may hear such standbys as "The Boys in the Backroom" and "Look Me Over Closely" done as only this peerless, and ageless, entertainer will ever do them. For those with equally sophisticated tastes there is Duke Ellington's "Liberian Suite" (BBR 8060). Music from the sound track of another of Disney's nature study films, "The Vanishing Prairie" can be heard on BBA 8058. There is a miscellaneous recital by the huge Salt Lake Tabernacle Choir on NBL 5012, and from the latest stock of classical LPs I would choose first the enterprising release of Stravinsky's opera "The Rake's Progress", performed by a fine Metropolitan Opera cast under the composer's direction (ABL 3055-7). Sung in the original English, it offers a refreshing chance to listen to a recorded opera and to know, just for once, what it is all about. The music is very "easy" to listen to, and altogether the issue is one to appeal to most shades of musical taste. It is deliberately written in the style of a Mozart opera, but all through it bears the mark of its fascinating composer. Another Metropolitan Opera release returns to familiar ground with Leoncavallo's popular "Pagliacci", in a remarkably vivid performance and recording (ABL 3041-2). Here you will meet the splendid Canio of Richard Tucker, who may fairly be claimed as the outstanding operatic tenor among native Americans of today.

In the pop sphere, Philips have Doris Day in two of the songs she sings in the cinemascope film "Love Me or Leave Me" (B 21625) besides popular instrumental numbers from George Liberace and his Orchestra, "Pizzicato Waltz" and "Skiddles" on B 21633, and from Percy Faith: "Not as a Stranger" and "Tropical Merengue" on B 21695. Kirk Stevens gives stirring treatment to "Scotland the Brave" and "Bonnie Gallowa" on P 26182. After this tuneful and entertaining matter, I regret to note Philips' continued allegiance to a sort of female Jimmy Boyd called Miss Gayla Peevey. Regarding her last record, "Daddy's Report Card", the handout tells us that "this young songstress is now at the apex of her career." The number of the disc is B 21664, and any recommendation to buy it comes from Philips rather than from me. Another disc which might cause embarrassment to the listener, though in a different way, is B 21696, on which that renowned Gospel singer, Mahalia Jackson, tears into two numbers called "I See God" and "His Hands". This is uninhibited singing of a type which sounds convincing only from negro artists and, however one feels about it, it is impossible to doubt its burning sincerity.

Nixa have entered the 45 "extended play" field with a lengthy list of releases culled from their light catalogue, and have issued also a number of operatic and orchestral excerpts in this same form. On LP they have some fine sounding light records to suit all tastes, with Lew White in theatre organ favourites (XLPY 136), some Viennese waltzes played by Armand Bernard's orchestra (LPY 128) and a stirring medley of pipe music from St. Columcille's United Gaelic Pipe Band (SLPY 147). If your taste in matters of physical sound happens to run in an opposite direction, you will enjoy Edward Vito's harp recital on SLPY 145, for the dulcet tones of this graceful instrument can rarely have been so successfully recorded. All who like putting their equipment through its paces will make for SLPY 153, which has a stupefying array of percussion instruments in impressive and sometimes highly amusing selections. On the same musical level, but much more restrained, are the offerings to be heard on a disc entitled "Music Boxes of Long Ago" (SLPY 158).

The latest classical release by Deutsch Grammophon maintains the high standard we have come to take for granted. That delightful opera "Suzanna's Secret", which was so well performed by the recently formed New Zealand Opera Company, will be found to make very pleasant hearing, especially by those who have a clear memory of what happens on the stage. It is given a good performance (in the original Italian, of course) by Esther Orel and Mario Borriello on DGM 18136. Some rarely

(Continued on page 49)

ELECTRICAL AND TRADE SECTION

Dealers should keep an eye on those

HANDYMEN IN THE HOME

A Little Electrical Knowledge Can be Dangerous

(Reprinted by Courtesy of "Wireless and Electrical Trader," Dorset House, Stamford Street, London, S.E.1.)

Busy with their normal orthodox wiring routine, electrical contractors would be surprised to hear of some of the less orthodox methods adopted by amateur wiremen about the house. These show that, in some cases, a chain of circumstances, coupled with untrained workmanship, will nullify even electricity's essentially safe and controllable nature.

A summary of thirty-eight fatal domestic electrical accidents in Britain for the year 1954 includes, for instance, an unfortunate method of connecting a vacuum cleaner. The cleaner was supplied with a three-core flexible cable, but it had been fitted to a two-pin plug, which, in turn, was attached to a bayonet-cap adaptor, which plugged into a lampholder.

THAT THIRD WIRE

In wiring the plug, the handyman had twisted the green core to the red core before connecting it to one of the terminals, with the result that the metalwork of the appliance became alive each time this pin happened to be connected to the live line. The housewife using the cleaner was electrocuted when she touched a fireguard attached to a metal grate. She had on a previous occasion complained of receiving a shock, but no action had been taken to trace the cause.

Similar conditions existed when a man was electrocuted by a heater. The three-core flexible was wired to a lampholder adaptor, leaving the green earth core free inside the adaptor. It made contact with one of the terminals which at the time of the accident happened to be on the live side.

Another case involving an electric iron occurred due to a combination of lack of earthing and a defective connector. In common with most connectors of this type, two bolts and nuts were required to hold the two halves together securely, but only one was fitted at the time of the accident, and this one was of such a length as to make contact with the iron when the connector was inserted.

Twin flexible cord had been used to supply the iron, and one of the cores had been nipped between the two halves of the connector adjacent to this bolt, and apparently contact between the bolt and the conductor made the metal casing of the iron alive.

RISKS OF NON-EARTHING

The non-earthing of an iron also caused the death of a baby. The baby was sitting on an aluminium draining-board in the kitchen, holding on to a water-pipe, when the mother put a live-framed iron on the draining-board. The iron was wired to a two-pin plug and had a broken terminal cover. One of the nuts securing the handle had dropped inside and wedged between the live terminal and the casing.

An unskilled attempt at radiogram repairing brought a death when a turntable motor became alive. A man had removed several parts from the inside of the cabinet and had made temporary connections using twin flexible and lampholder adaptors. The motor, being removed from its usual mounting, was unearthed and became live through a fault.

FENCE BECAME "LIVE"

Another accident was caused by a man transferring a radio chassis into a new cabinet. He took a bare wire from the aerial connection on the chassis through a hole in the back of the cabinet and outside to attach to a wire fence. The wire made contact with a live-point in the receiver and electrocuted a child who was touching the fence.

Several of the other accidents which occurred in the home were due to wiring or extensions by amateurs where the single-pole switch controlling the supply had been connected in the neutral conductor, so leaving the outlet live even with the switch off.

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. For further particulars contact Advertising Manager, R. & E., Box 8022, Wellington.

THE NEW CLIPPER FAN-HEATER

The Clipper fan-heater is a most attractive appliance that will prove itself invaluable to every home in New Zealand, for who does not know the feeling of warm hands and feet and a cold back when crouched over the conventional open or electric "fire"?

The fan-heater is still quite a novelty in New Zealand, but it is sure of ready acceptance. As its name implies, the Clipper fan-heater will:

(1) Circulate air at room temperature.

(2) Circulate air heated by one or two 1,000-watt elements with independent switching.

The fan operates immediately the appliance is connected to mains; a first switch operates the first 1,000-watt element and a pleasantly warm-looking red glow lamp; a second switch brings in a further 1,000-watt element.

The whole appliance is completely portable—12 in. long, 12 in. high (including handle), 7 in. deep—and the Clipper fan-heater has this advantage, too: it is safe. The whole thing is enclosed, and the most precocious child would be hard put to harm itself.

In bronze or grey hammer finish, the Clipper fan-heater retails at £9 15s.

New Zealand distributors: G. A. Wooller & Co. Ltd., Head Office, P.O. Box 2167, Auckland.

* * *

EKCO RADIO RECEIVERS MAKE WIDE APPEAL

The first two models of the EKCO range of receivers have recently been released by Ultimate-Ekco (N.Z.) Co. Ltd., Quay Street, Auckland. These receivers have been assembled in New Zealand and combine new features that have been immediately attractive to the buying public. Both receivers are fine performers combining craftsmanship with pleasant design.

6-VALVE BANDSPREAD LOWBOY RADIOGRAM "ROYALIST"

This new radiogram is housed in a cabinet designed on contemporary lines, particularly for the modern home. The cabinet is built of mahogany veneers, has a full-length lid, and a record compartment conveniently situated near the controls and record changer, at the top of the cabinet.

A bezel mounted at the foot of the cabinet serves as a power indicator, while on the front of the cabinet near the top the volume control is mounted. This enables volume adjustment to be made without the necessity for raising the lid.

The receiver features two pointers and an attractive open calibration dial. Station recognition and ease of tuning are characteristics of this set. The left-hand pointer is for shortwave stations, and the right-hand pointer is for broadcast stations.

Specifications

Valves: 6BA6, R.F. amplifier; EF41, I.F. amplifier; EL41, power amplifier; 6BE6, frequency changer; 6AV6, second detector; 6x4, rectifier.

Output: 4 watts (approximately).

Coverage: Band 1, broadcast, 1600-550 kc/s.; band 2, shortwave, 31-41-49 metres; band 3, shortwave, 25 metres; band 4, shortwave, 16-19 metres.

Record Player: Three speed automatic.

Speaker: 12 in. Rola P.M.

Dimensions: Height, 29½ in.; width, 34 in.; depth, 17 in.

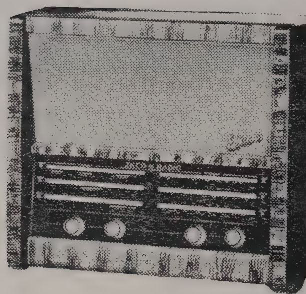
Code Name: Royalist.

Price: £97 17s. 6d.

6-VALVE BANDSPREAD MANTEL "CORONET"

An attractively designed mantel receiver in a cabinet of modern approach in selected walnut veneers. Engi-

(Continued on next page)



neered for New Zealand conditions, the receiver has selectivity, sensitivity, and a true tone reproduction. An improved tone network gives greater bass boost, and the set incorporates a stage of R.F. amplification.

This model also features twin pointers and a clear easy-to-read dial scale of generous proportions. Provision has been made for record player input and also for an extension speaker.

Specifications

Valves: 6BA6, R.F. amplifier; EF41, I.F. amplifier; EL41, power amplifier; 6BE6, frequency changer; 6AV6, second detector; 6x4, rectifier.

Output: 3½ watts (approximately).

Coverage: Band 1, broadcast, 1600-550 kc/s.; band 2, shortwave, 31-41-49 metres; band 3, shortwave, 25 metres; band 4, shortwave, 16-19 metres.

Speaker: 6-9H elliptical Rola P.M.

Dimensions: Height, 14½ in.; width, 19 in.; depth, 9 in.

Code Name: Coronet.

Price: £39 17s. 6d.

Manufactured and distributed by Ultimate-Ekco (N.Z.) Co. Ltd., P.O. Box 1166, Auckland.

* * *

"VALVES FOR A.F. AMPLIFIERS," by E. Rodenhuis.

A valuable instruction booklet at the very low cost of 10s. 6d.

Although all kinds of good amplifiers are available on the market, many radio amateurs, especially budding technicians, prefer to build their own, not only to save money, but for the satisfaction of experimentation and creation.

This booklet of 152 pages, with 97 illustrations, shows the radio designer and amateur set-maker how this can be done. The author has assumed that the majority of his readers will be practically-minded, and has accordingly kept theoretical details to the minimum. The book contains a wealth of information and practical hints, with the object of weaning the reader from the popular procedure of constructing equipment from a ready-made blueprint.

It takes him, through the principles of construction on the basis of a schematic diagram, to the design of equipment according to his own ideas and specifications. Experimentation along these lines affords more satisfaction, whether the work is for profit or for a hobby. The book is centred mainly on the fullest possible data relating to a number of valve types which were specially designed for use in sound amplifiers—viz., the amplifying valve types EF40, EF86, ECC40, ECC83, EL34, EL84, and the rectifying valve type GZ34. Much thought has been devoted to the specification of the components, their lay-out on the chassis, the method of assembly, tone controls, and mixing circuits.

The most important part, which will also be of interest to the more routined technician, is that dealing with the design of eight complete amplifiers. It comprises a series of designs for an output of 3w. to 100w., which, as will be seen from the numerous curves and tables of results included, are by no means drawing-board examples.

With its many supplementation tables of valves and components, this handy sized and moderately priced book will also prove useful for reference purposes.

Distributed in New Zealand by Philips Electrical Industries of New Zealand Ltd., P.O. Box 2097, Wellington.

* * *

PYE HI FI AUDIO AMPLIFIER PF91 REMOTE CONTROL UNIT PF91A

Hi Fi (High Fidelity) enthusiasts will welcome the news that a first-class audio amplifier and a remote control unit are now available direct from Pye Ltd.

The PF91 amplifier, with its PF91A remote control unit is the culmination of many years of research into the problem of high fidelity reproduction by Pye engineers. Its performance will astound the ordinary listener and critical engineer alike.

The PF91 is neither high, low nor middle brow, but serves all tastes alike. It is as faithful to Gershwin as to Beethoven—Limehouse Blues emerges as melodiously as does the Ninth Symphony, triumphantly.

Record players, tape recorders, microphones or radio tuners can be used with the PF91. The Remote Control and Pre-amplifier unit may be placed in the most convenient operating position and the amplifier can be installed in the loudspeaker cabinet or in a convenient cupboard.

Here and now, in the PF91 amplifier, is a versatile and practical unit for those who demand perfect sound reproduction in the home, the music or the social club.

PF91—Special Features

26 db negative feedback and an output from 2 c.p.s. to 160,000 c.p.s. (over 16 octaves).

A combination of negative and positive feedback raises the damping factor of the amplifier to infinity thereby ensuring full control of loudspeaker speech coil movement.

The accurate reproduction of sounds rich in harmonics sets a new standard in the enjoyment of modern recordings.

The output transformer is a specially designed component to meet the exacting specification of the amplifier.

The Power Amplifier is capable of handling peak power pulses in excess of the maximum rating without noticeable distortion.

PF91A—Special Features

This unit enables remote control of the amplifier up to a distance of 20 ft. (6 m.).

(Continued on page 43)

TRADE WINDS

HIS MASTER'S VOICE AND CAPITOL, U.S.A.

Mr. A. J. Wyness, Managing Director of His Master's Voice (N.Z.) Ltd., has announced that the parent company, Electric and Musical Industries Ltd., Hayes, Middlesex, England, has acquired the controlling interest in the Capitol Recording Company of America, and, as from January 1, 1956, has taken over the sole distribution of recordings made under the "Capitol" label.

Mr. J. M. Burnett, Managing Director of the Australian company, E.M.I. (Australia) Pty. Ltd., arrived in New Zealand on February 18 to finalize with Mr. Wyness arrangements in this connection.

It is interesting to note that recording sessions have now commenced in the new thirteen-storey Capitol Tower in Hollywood, the world's first round office structure; also that in December two world-famous Capitol artists, "Tennessee Ernie Ford for "Sixteen Tons", and movie star Dean Martin for "Memories Are Made of This", were presented with gold discs marking a million sales in America.

* * *

PYE INTEREST IN OPTICAL COY.

Pye Limited of Cambridge, England, has acquired a substantial interest in W. Watson and Sons, of Barnet and London. Founded in 1837, Watsons are pre-eminent in the optical and scientific industry. The many products for which they have a world-wide reputation include a complete range of microscopes.

Watsons have expanded their interests into the photographic lens industry, and the Watson Zoom lens is in use on TV networks throughout the world. The company makes all the optical and mechanical components for its range.

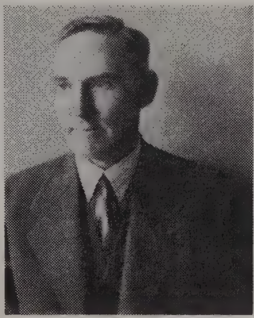
No alteration is contemplated in the present management or policy of the Watson Company, nor in its marketing arrangements.

* * *

ULTIMATE-EKCO FUNCTION

At the end of the working year the staff of Ultimate-Ekco (N.Z.) Co. Ltd., enjoyed a very pleasant breaking-up party in their cafeteria. A notable event was the presentation of awards for 25 years' service to two of the staff. In the course of the short ceremony tributes were paid to Mr. W. D.

Mr. D. T. Clifton-Lewis presenting Service Badges at Ultimate-Ekco's Christmas Party.



MR W. D. JAMES MR G. C. NUNNS

James and Mr. G. C. Nunns for their loyalty and personality and the whole staff joined in congratulating them on completing 25 years' service. Each received a very fine illuminated address and silver tea service and the coveted 25 years' service lapel badge.

Many other members of the staff were presented with lapel badges to mark varying periods of service, ranging from 5 to 20 years. The Managing Director, Mr. D. T. Clifton-Lewis, presented the badges and also the annual awards to the most improved male and female member of the staff. The latter awards were won this year by Mr. C. Pritchard and Mrs. A. Guest.

This concluded the formal part of the function and from then on the party developed a splendid spirit and made a fitting climax to a successful and happy year of work at Ultimate-Ecko.

* * *

HALLAMORE HOUSE LTD.

Hallamore House Ltd., manufacturers' representatives and importers, P.O. Box 2365, Wellington, have just established their Wellington headquarters at 21 Everton Terrace.

With the "Quickdraw"—an aid for quick sketching —they look forward to assisting draughtsmen, amateur and professional, students, and, in fact, anyone concerned with designing or drawing, including the self-service man, in the rapid production of sketches, line drawings and electrical wiring diagrams.

Other interesting lines, including Wandsworth Electrical Accessories, are also scheduled for an early introduction to the New Zealand market, and we look forward to hearing more from this enterprising firm in future.

* * *

NEW B.S.R. REPRESENTATIVES IN NEW ZEALAND

Birmingham Sound Reproducers Ltd., manufacturers of the famous Monarch Record Changers, have recently appointed that go-ahead firm of David J. Reid (N.Z.) Ltd., of 271 Victoria Street West, Auckland (P.O. Box 2630) as their sole New Zealand factory representatives.

All inquiries for this B.S.R. product will be welcomed by Messrs. David J. Reid (N.Z.) Ltd.

PYE PLANS

Front row (left to right): Denis Anear, Noel Bateman, Ron Skinner, Colin Carnachan, Darge Stuart, Bob Souter, Bert Staff, Colin Moore, T. J. F. Spencer, George A. Wooller, A. M. Cooper, Brian Brailsford, Frank Marker, Dan Coronno.

Back row (left to right): Bernie Bookman, Ross Pulham, Ted Grant, West Mahood, Gordon Rowe, Arthur Kay, Max Hunt, Fred Noad, Jack Walch, Ray Fitt, Guy Thornton.

Just what was decided and who said what to whom, we are still in the dark about, but the Mt. Eden Tea Kiosk, on one of Auckland's extinct volcanoes, was recently the venue for a Pye staff luncheon when they gathered together in Auckland for a general discussion of the way to go for 1956. Many smiling faces were caught by the photographer before lunch, and not a few of them will already be known to our readers.

We gather that 1956 could well be a momentous year for Pye Ltd. under the inspired (and we use the word after due consideration) leadership of George Wooller. To anybody who has been associated at all closely with the company in recent years, progress, as reflected by increases in staff and premises, has been surprising to say the least.

Parenthetically, did you know that George Wooller is now not only chairman of Pye in New Zealand, but of the Australian company (Pye Australia Pty. Ltd.) as well, and that he is the only man outside England to be on the board of the parent company in Cambridge? Even Mr. Wooller's most immediate business rivals will agree that there are grounds for congratulation. Further news from the same stable (if Pye will forgive the expression) is that the Pye company is now Pye Ltd., and not Pye (New Zealand) Ltd. as before; and that Pye are again expanding into new accommodation.

The move to occupy more floor space is, as we said earlier, an indication of the continuing growth and prosperity of the companies under Mr. Wooller's control. The address of the company remains the same although some of the staff are being moved into Johns Buildings, Chancery Street, and further floor space is being taken over in Chancery Chambers. Total floor space of the Auckland offices and showrooms is now in excess of 12,700 square feet.

It's small wonder that the executive and sales force found something to talk about at their staff conference, if they are planning (as no doubt they are) to continue this rate of progress.

NEW YEAR GIFT

At last the eagerly awaited New Year gift has arrived for L. W. Taillie of Fears' Radio Co. Ltd., Upper Hutt—a fine son.

Congratulations to Mr. and Mrs. Taillie.

COSSOR APPOINTS NEW REPRESENTATIVE IN NEW ZEALAND

Though long established as Electrical and Mechanical Engineers and Importers, Messrs B. R. Homersham Ltd., of 126 Victoria Street, Christchurch (P.O. Box 280), are newcomers to the radio field. With their apointment as New Zealand representatives for that famous English firm of Cossor Instruments Limited of London, manufacturers of test instruments, we expect to hear much more of B. R. Homersham Ltd., in the future.

The Wellington representative of this firm is Mr. Tattersfield of P.O. Box 572, while, in Auckland, Homershams are represented by W. and K. McLean Ltd.

* * *

A DISTINGUISHED VISITOR

Recently one of England's well known men in industrial circles, Mr. Frank Allen of Messrs. E. K. Cole Ltd., paid a short visit to New Zealand in the course of a world tour. He covered a great deal of the world, visiting many countries and establishments with which Messrs E. K. Cole have associations.

While in Auckland he visited Messrs. Ultimate-Ekco (N.Z.) Co. Ltd., and was interested in the premises, plant and plans of that company. He met many of the staff and was able to take back to England, an up-to-date picture and at the same time give news of recent developments in England.

Mr. Allen is a friendly man who is often called on to address study groups for he is an authority on radio production engineering. He is also a director of Messrs. E. K. Cole, and Works Controller for all their works.

Even though his visit was a hurried one, time was found to visit Waitomo and Rotorua in the company of Mr. Clifton-Lewis, managing director of Ultimate-Ekco (N.Z.) Co. Ltd., and Mr. Allen's stay was made a pleasant one. Close-co-operation and personal contact between E. K. Cole and Ultimate-Ekco will be maintained with much benefit to all.

MORPHY-RICHARDS' DEALERS' CONFERENCE

A happy band of distributors and dealers featured at the Morphy-Richards Conference held at the Tea Kiosk, Mt. Eden, Auckland, during the visit to New Zealand of Mr. Lionel St. James, Export Sales Manager of Morphy-Richards.

(See story on page 44.)

PYE LIMITED TO FORM FRENCH COMPANY

Pye Limited announces the impending formation of a French subsidiary company, to be known as Pye (France) S.A.

The French company will be primarily engaged in the active introduction into the French market of the entire range of Pye telecommunications products.

Great interest has already been shown in Pye two-way mobile radio, for which orders have already been received. Prospective buyers have been impressed by the potential savings in time and petrol, as well as the increased efficiency which can be effected through the use of radio.

Since the war, the increase in the volume of Paris traffic has tended to slow down transport in the city. Many industrial and commercial users expect to overcome the delays caused by traffic blocks by controlling their vehicles with two-way radio schemes.

PHILIPS' EXPANSION

Industrial development in the Hutt Valley will this year be further expanded by the erection of a six-acre production centre for radio, electronic, and television apparatus.

This new production centre is already under construction in Naenae Road, Lower Hutt, for Philips Electrical Industries of New Zealand Limited. The world-wide Philips organization has factories in 27 countries.

The layout makes provision for the manufacture of commercial television receivers, thereby anticipating a market for sets best suited to local conditions when a TV service commences operation.

Commenting on his firm's anticipations, the Managing Director, Mr. Leighton Lord, said recently:

"We have no doubt that public interest in TV will be as enthusiastic in New Zealand as it has been elsewhere and are making plans accordingly. All the same, it is a misconception to think that television will replace radio. The two services are functionally different and one does not replace the other. At Naenae we shall be carrying out research and production for both."

New Products

(Continued from page 40)

Cathode follower output from the Remote Control Unit reduces cable losses when the Power Amplifier is remotely controlled.

Four switched inputs and the choice of three equalization networks for L.P., N.A.B., and 78 recording characteristics.

Continuously variable lift and cut controls for bass and treble with clearly marked level positions.

Incorporates a treble filter control giving three sharp cut-off frequencies and an unrestricted response position.

The Pre-amplifier incorporated ensures sufficient gain on all inputs for the full loading of the Power Amplifier.

The Pye PF91/91A Hi Fi Amplifier and Remote Control Unit retails at £58.

The PF91 and PF91A are distributed by the Special Products Division of Pye Ltd., Imperial Buildings, Queen Street, Auckland, and 43 Lower Taranaki Street, Wellington.

* * *

NEW PYE 101

Quality, performance and tone are watchwords that Pye have followed ever since the introduction of the brand to New Zealand some years ago. The new model 101 has all these in full measure but its most outstanding feature is assuredly its looks.

The 101 is a delightful mantel model finished in mahogany and brought to a gleaming polish. The cabinet shape is arresting, neat and pleasingly tasteful. Neither ultra modern nor period it is likely to prove acceptable to all those who want something more in a moderately priced radio than the conventional plastic cabinet. Dimensions are: 16 in. wide x 12¼ in. high and 7½ in. front to back.

For a model of this kind the Pye 101 is very moderately priced at £28 7s. 6d. (retail). It is a

(Continued on page 53)

MORPHY RICHARDS' PROGRESS IN NEW ZEALAND

Following the New Zealand Board of Trade inquiry into tariff rates for domestic electric irons, Mr. Eyre, Minister of Customs, recently announced new import regulations for this item.

Immediately upon receipt of this news, Mr. L. D. St. James, export sales manager of Morphy-Richards Ltd. of London, who are reputed to be the largest manufacturers of automatic electric irons in the world, caught the first plane to Auckland, travelling via the new Polar route across the United States.

The effect of these new regulations will mean that locally-made New Zealand irons will now be supplemented by products imported from their main factory in England and the range will extend to a selection of no fewer than twelve automatic irons, including the different attractive finishes, together with some interesting new lines.

Mr Lionel St. James demonstrating Morphy-Richards products at the recent Morphy-Richards Dealers' Conference.

Morphy-Richards Ltd. were one of the first companies to make arrangements for the production of small electrical appliances in New Zealand. A second factory in Auckland produces a compact refrigerator which, because of its convenient size and exceptionally low price, has proved most popular with New Zealand householders, and, in fact, over the last few years they have been installed in more than 25,000 homes here.

The progress of the Morphy-Richards firm has been amazingly fast, for only in 1936 the two founders were working with just a handful of men in a disused stable. Their weekly production in the United Kingdom today is more than 50,000 domestic irons a week plus a complete range of automatic toasters, hair dryers, door chimes, heaters, radiators, spin dryers, and refrigerators. Their export business has been cited on many occasions by the British Board of Trade as an example to other industries, because they export regularly to 115 different countries more than 3,000 irons a day. They have just supplied their 400,000th toaster to Canada in the face of fierce American competition, and in Norway, amongst continental competition, one Norwegian housewife in three has purchased a Morphy-Richards iron in the last four years.

Mr. St. James, who last year visited all countries in South America, Africa, and the Far East, said, before leaving for Australia and Hong Kong, that the electrical dealers in New Zealand should be encouraged to offer greater instruction on the use of appliances. This general education would not only increase their business, but would enable the New Zealand housewives to choose and use their home appliances more efficiently.

View of one of the Morphy-Richards' Assembly Lines in Kent, England.

During Mr. St. James' visit to New Zealand, a well-attended Morphy-Richards Dealers' Convention was held at the Mt. Eden Tea Kiosk, Auckland, on Wednesday, 18th January. A most informative talk was given by Mr. St. James on the whole range of Morphy-Richards appliances shortly to be presented on the New Zealand market, and the display of several attractive new lines captured the interest of all present.

Apart from the now famous Morphy-Richards automatic toaster, hair dryer, door chimes, and automatic dry iron Type CA.75, a varied new range of automatic irons was shown and demonstrated, including the new lightweight "Atlantic" iron and the steam iron. The new range of irons will be available in a variety of finishes, and will retail from £2 19s. 6d. inclusive of plug. Also on display were electric blankets, space heaters, and a compact absorption type 1.5 cu.ft. refrigerator.

Morphy-Richards irons have been made in New Zealand by the Dominion Radio and Electrical Corporation Ltd., of Otahuhu, and the complete range of small appliances such as automatic dry irons, automatic steam irons, automatic toasters, hair dryers, door chimes, etc., are now being imported and distributed by Russell Import Co. Ltd., Wellington. The refrigerators are made and distributed in New Zealand by H. O. Wiles Ltd., of Auckland. —P.B.A.

For the Technician

Morphy-Richards Auto-Control Safety Electric Irons Part 2

SECTION 5

Switch and Thermostat

(1) **Contacts Open:** A fault occasionally found is that the contacts remain open when the control knob is at the "art silk" position, even though the iron is cold. If satisfied that the remainder of the circuit is in order, the fault must be investigated after further dismantling.

(2) **No Cut-out:** In the event of the thermostat failing to cut-out, the origin of the fault is often untraceable owing to damage from over-heating. In this case replace all damaged or faulty parts. Otherwise, proceed as follows:—

(a) Check operation of thermostat—i.e., see whether contacts open on heating. If they do, check the insulation as in Section 4. If the insulation is apparently in order, remove and replace the terminal block assembly (35501), as the insulation between the contact leaves has evidently broken down. (This can be verified after removal by separating the leaves and testing the insulation between them.)

(b) If the contacts do not open, note whether they have become welded together. This usually indicates than an A.C. iron has been used on D.C. It may also be caused by an element short-circuit.

Referring to (b), should it be required to operate the iron on D.C., it is necessary to fit a universal type of thermostat (35521) instead of the normal one (35501).

(c) Should contacts fail to open and are not stuck, set cam for "art silk" by means of control knob. Connect to supply, allow to heat up to 150° C., and note whether adjusting pin rises. If not, the fault is in the bi-metal.

SECTION 5a

Additional Information Necessary for the Servicing of Irons Equipped with the Crossbow Terminal Block Assembly

Brief Description

The circuit is generally as the earlier type of iron, with the exception of the thermostat, which, although inter-changeable, is an improved arrangement. The new thermostat is virtually radio-interference free, and because of its greater stability, it will result in an appreciable increase in element and contact life.

The new switch consists of three spring leaves. The upper leaf is controlled by the bi-metal as before, but in place of a contact it carries a short strip welded across it, at the ends of which are welded thin alloy steel tapes. These tapes are connected to an intermediate leaf which is biased lightly downwards. The intermediate leaf is electrically insulated from both upper and lower leaves and carries a silver contact which co-operates with another contact mounted on the lower spring leaf in the usual way. The circuit, therefore, is through the upper leaf, down the two tapes in parallel to the intermediate leaf and its contact, and if the switch is closed, from this contact to the lower leaf contact and thence to the element.

As the sole-plate temperature rises, the bi-metal strip deflects, and thus the adjusting pin and nut move upwards. Since the upper and lower spring leaves are biased upwards, they rise with temperature increase until the ceramic bead on the lower leaf is arrested by the cam. Further temperature rise brings the tapes, heated by the current which is passing through them, into tension and ultimately the contacts part, the circuit is interrupted, and the tapes cool, contracting as they do so. This contraction gives the clean break which is characteristic of the switch. When the bi-metal has cooled an amount to reclose the contacts, the tapes expand and give an immediate positive contact pressure.

The control of temperature by the cam and the adjustment via the nut and pin is as the standard arrangement.

The condenser for universal working is placed across the contacts—i.e., between the intermediate and lower leaves).

Fault Finding and Servicing

(1) Check that the alloy steel tape connecting the intermediate and upper leaves is undamaged.

(2) Check that the insulation between the intermediate and upper leaves is undamaged. When the iron is connected to a mains supply, there should be a voltage drop of approximately 1 volt across these leaves.

(3) See that the mica washer is in place between the upper and intermediate leaves, and centred on the porcelain insulator.

(4) Note that the condenser fitted to the universal type is connected across the contacts—i.e., across the intermediate and lower leaves, NOT the switch as a whole.

(5) Setting should be carried out as in Section 10, except that in the case of irons having Crossbow T.B.A.s 10° C. should be added to all figures given.

SECTION 6

Dismantling Chassis

(1) To Remove Bridge Assembly (30619)

Take out the two fixing screws or nuts and lift off.

If bridge is abnormally stiff or there is undue "plat" in the bush, change bridge assembly.

(2) To Remove Block Assembly (35501)

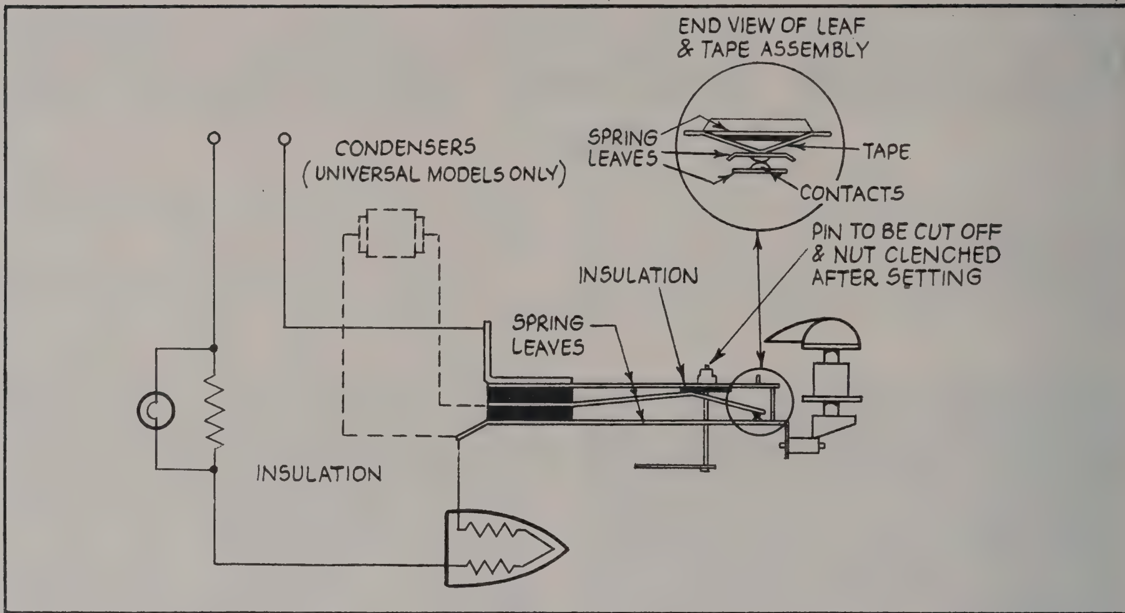
(a) Unscrew the adjusting nut (30629) on pin (30625).

(b) Take out the two screws or nuts fixing thermostat block to clamp plate.

(3) To Remove Clamp Plate (N.Z. MR 57)

(a) Unscrew two rear fixing screws or nuts.

(b) Remove the large front nut (20155 N).



THE ELECTRICAL CIRCUIT

(c) Lift off the clamp plate and asbestos liner, which will usually be found stuck together. The asbestos pad should be scraped off and scrapped.

(d) The element and nameplate can now be detached.

Do not remove clamp plate unnecessarily, as removal will probably damage element micanite.

SECTION 7

Element N.Z. MR 55

Element failure, if indicated by the tests in Section 4, can now be investigated.

(a) Insulation breakdown is usually obvious on inspection. Occasionally only a small pin-hole in the mica is visible.

(b) A burn-out of the element tape is also usually obvious on inspection, as the mica has often burnt away, and, in fact, the fault is combined with an insulation breakdown. If the break is not clearly visible, confirm by testing for continuity.

(c) Should the mica element cover-plates be flaking, the element must be replaced even though no fault was shown on insulation and continuity tests.

SECTION 8
Bi-metal

Faults in Bi-metal Action

These will have been indicated in tests carried out in Section 5.

(a) The adjusting pin may be damaged at the foot, or the bi-metal strip may be loose.

(b) The bi-metal may not be returning to its free or flat position when cold.

This may be caused by—

(c) Foreign matter, such as a chip of porcelain having found its way underneath the strip.

(d) The bi-metal strip may have moved under its clamp (30624) so that the foot of the pin is no longer free, and is wedging up the tip of the bi-metal strip. This is impossible with the latest pattern.

(e) If all else fails, it is possible that the bi-metal has at some time been reassembled upside down. This can be verified by testing as explained in Section 9 (Reassembly).

SECTION 9

Reassembling Chassis

(1) Inspect sole plate to see if the plating has been damaged or is showing any sign of blistering, and examine upper surface for any damage possibly caused by arcing in the case of an element failure. The sole plate must be replaced if it shows defects in either of these directions.

Insert the front fixing stud (20324) and screw nearly home.

Bi-metal (30621)

(1) Scrape any grit or grinding residue from the recess in which the bi-metal seats, and fix the bi-metal and its pin. **Pin to be inserted with foot towards the front.**

(2) To ensure that the bi-metal is mounted the right way up, it must be placed with the indication tongue on the right-hand side looking from the rear. If you have any doubt, warm the bi-metal with a match, which will cause it to bend. It must then be assembled so that the free end RISES on heating.

(3) When clamped, the bi-metal must be free at the forward end and not pressing on the bottom of the recess in the sole plate. The pin must be free to move slightly from its vertical position without raising the bi-metal.

(To be concluded)

MAKE YOURSELF AN ELECTRIC BLANKET

With winter not so far away, most people who do not possess one will be thinking of acquiring an electric blanket. Messrs. Tele-Communications Ltd., 27 Tory Street, Wellington, well-known makers of radio and special transformers, have recently come up with the most attractive thing in electric blanket units we have yet seen. The "Teleco" embodies several original ideas, all of which should appeal strongly to prospective electric blanket users.

First of all, it is a low-voltage device—much the safest and most satisfactory type of blanket heater—with three degrees of heating, instantly available at the turn of a switch. In all three positions, the power may be left on indefinitely without danger of over-heating either the element or the bedding. It is thus possible to turn the heat fully on for a quick warm-up, reducing to medium or low thereafter, according to the needs of the moment.

The second feature of importance is that the transformer and its switch are built into an attractive bedside lamp, illustrated here. Most other units of the same kind are merely a small (or not-so-small) box which must be placed on the bedside table or on the floor, and in either position these are apt to be a nuisance, taking up useful space. Building the "works" into a bedside lamp, as in the "Teleco" unit, makes the latter not only useful in its own right, but decorative as well.

The third unusual feature is that the unit includes in the price sufficient special insulated wire, which is the actual heating element. The idea is to take a piece of suitable material, such as an old sheet, sew a number of rows with the machine, making a series of parallel channels about an inch wide, spaced over the whole width of the doubled material. The wire is then threaded through the channels thus made for it, after which the ends are connected to the socket provided on the transformer unit. The blanket is then placed on the bed under the bottom blanket, and it is ready for use. The enormous advantage of making the blanket portion oneself is that the whole unit, complete with element wire, sells at something like £10 less than most ready-made electric blankets. With this and the other advantages detailed above, the "Teleco" blanket unit should find a very ready sale—not only in the "deep south", either! P.B.A.

Record Talk

(Continued from page 36)

heard German opera is contained in a disc by a fine baritone, the late Georg Hann, who is heard in solos from popular works by Cornelius and Lortzing on DGM 18003. Of the standard classics, Tchaikovsky's fifth turns up again as played by the Berlin Philharmonic under Ferenc Fricsay (DGM 18012) and Beethoven's fifth receives a splendid performance by the same orchestra under Eugen Jochum (DGM 18097). Among the forthcoming Argo releases is a disc of short pieces by the genial English composer Balfour Gardiner. Naturally enough the universally known "Shepherd Fennel's Dance" is included, but three other pieces, "Philomena", "April", and "Overture to a Comedy", are making their first appearance on records. All are played by the London Symphony Orchestra conducted by Richard Austin, with the Goldsmiths' Choral Union participating in "April" and "Philomena". The number is RG 69. RG 70 has a recital of authentic songs of Mexico, sung in forthright style by Carmen Prietto, with guitar accompaniment by Bert Weedon.

H.M.V. provide a number of children's records in the "Lone Ranger" series, and in addition there are two narrative discs by Sterling Holloway which should also interest the juniors: the story of "Pineapple Poll" on KN 1010 and that of "Susie, the Little Blue Coupe" on KN 1014. Bill Haley is still riding on the crest of the wave with "Rock a'beating Boogie" and "Burn that Candle" (DNZ 5157) and the long line of Slim Whitman releases is continuing evidence of the demand for numbers by this entertainer. His latest (London HL 8167) offers an amusing contrast, since "I'll Never Stop Loving You", on one side, is followed by "I'll Never Take You Back Again", on the other, so presumably you can have it either way. Perry Como has a new hit in "Tina Marie", backed on HR 10130 by a number called "Fooled", and the Ink Spots are back with "Don't Laugh at Me" and "Keep it Moving" on NZP 30.

The main LP supplement is once again overwhelming. There is a recital of arias, mostly from Verdi operas, sung by one of the finest sopranos of our time, Zinka Milanov, on ALP 1247. Those who sampled her singing in the complete "Trovatore" will know what to expect, and in sheer beauty of voice she yields nothing to Callas or Tebaldi. The most interesting and unusual of the H.M.V. releases is ALP 1251, on which Rafael Kubelik and the Chicago Symphony Orchestra play the "Five Pieces" by Arnold Schonberg. This work made history at the London "Proms" around the year 1912, for Sir Henry Wood recalled in his autobiography that this was the only occasion in the long history of those concerts, on which a new work was actually hissed by the audience. Listeners to the Schonberg pieces as here recorded are more likely to be baffled than outraged. Performance and recording alike are of fantastic brilliance, and Hindemith's "Symphonic Metamorphosis on themes by Weber", occupying the reverse, is quite prosaic music by comparison. On BLP 1073 Joan Hammond revives the fine Beethoven concert aria, "Ah Perfido", which was once thrillingly recorded by Kirsten Flagstad. By a strange coincidence this piece, so long out of the catalogue, turns up again this month, in a performance by Elisabeth Schwarzkopf which fills up space on the Colombia release of Beethoven's fourth symphony, conducted in a clear and leisurely rendering by Herbert von Karajan (33CX 1278). Hammond has perhaps the more suitable voice for this dramatic piece of music, and her disc is rounded off with some rarely heard excerpts from operas by Berlioz and Saint Saens.

There are some attractive bargains on H.M.V. plum label. A big selection from the ballet "Coppelia" played by the Covent Garden Orchestra (CLP 1046), a splendid performance of Tchaikovsky's B flat minor piano concerto by Gina Bachauer and the New London Orchestra under Alec Sherman (CLP 1049) and a useful revival of old Noel Coward-Gertrude Lawrence favourites, in the original recordings by the artists themselves, happily transferred to LP (CLP 1050). Then on DLP 1079 we have a rousing collection of numbers by the Boston Promenade Orchestra: "Poet and Peasant", "Hora Staccato", "Orpheus in the Underworld", and Paganini's "Moto Perpetuo". These, by the way, are brand new versions, not transfers from the earlier ones.

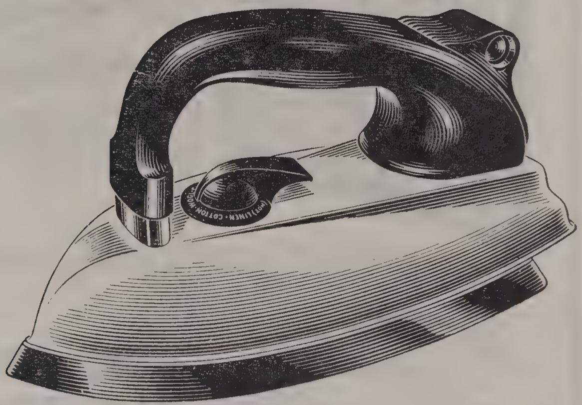
Columbia have a brilliant recording of Khachaturian's violin concerto, played by Igor Oistrakh (son of the famous David) with the Philharmonia under Goossens (33CX 1141). Igor's father happens to feature in the same release, with performances of the Concerto No. 1 by Prokofieff and the well liked G minor concerto of Bruch, with the London Symphony Orchestra conducted by Lovro von Matacic (33CX 1268). This conductor, who has made a number of impressive records of late, comes into his

(Continued on page 53)

A new and bigger range of

MORPHY-RICHARDS

IRONS



at new **LOW** prices!

Morphy-Richards Senior Medium-weight Iron (above right); C.A.75, metal body:
Chrome, £3 7s. 6d. retail.

"Epicoat" (Primrose, Green, Blue), £2 19s. 6d. retail.

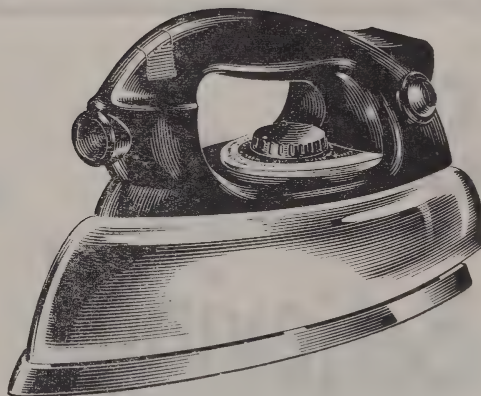
P.A.75, Porcelain body, Primrose, Green, Blue, £3 4s. retail.

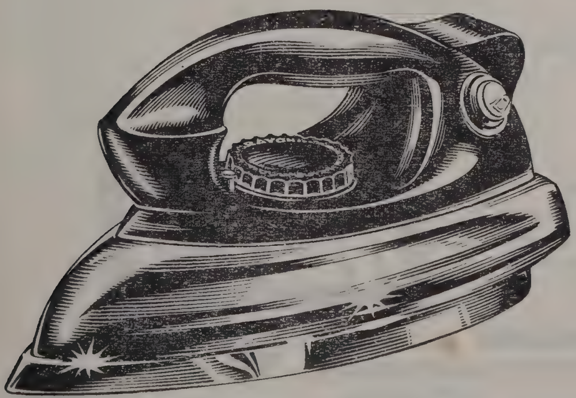
Morphy-Richards Atlantic Lightweight Iron (below), L.A.75; metal body:
Chrome, £3 11s. 6d. retail.

"Epicoat" (Primrose, Green, Blue), £3 6s. retail.

Morphy-Richards Steam and Dry Iron (right): Z.A.75, Chrome:
£4 17s. 6d. retail

All prices include plug





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New Products

(Continued from page 45)

6-valve, including magic eye, broadcast set that is as pleasing to hear as it is to see.

Sole New Zealand distributors: Pye Ltd., Box 2839, Auckland, and branches at 43 Lower Taranaki St., Wellington, and 16-18 Victoria St., Christchurch.

* * *

PUSH-BUTTON MODEL BY CLIPPER

Clipper's first venture into the push-button car radio field looks like being a highly successful one, and it opens up great possibilities for radio dealers more especially those not already stocking this type of set.

The PB8U6 is an 8-valve, two-pack model, with separate tuning head and power pack. The speaker escutcheon is finished in brushed chrome and looks most attractive and suitable for fitting in every make of new car, and the older models too!

An unusual feature of the PB8U6 is the tone control arrangement. Two separate tone controls are fitted: one on the power pack which is used for semi-permanent tone adjustment and another incorporated in a push-pull switch in the volume control. An elliptical loudspeaker is housed in the power pack.

Undoubted quality and performance, coupled with a retail price of £37 10s., will ensure a steady demand for this new Clipper push-button car radio.

Sole New Zealand distributors: G. A. Wooller & Co. Ltd., Box 2167, Auckland, and at 43 Lower Taranaki Street, Wellington, and 16-18 Victoria Street, Christchurch.

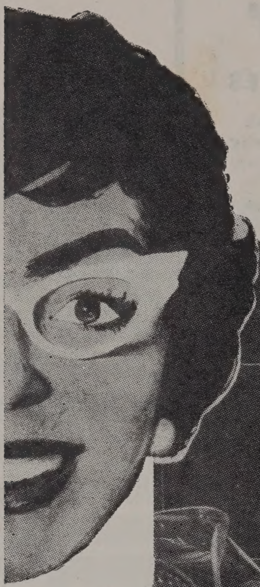
Record Talk

(Continued from page 49)

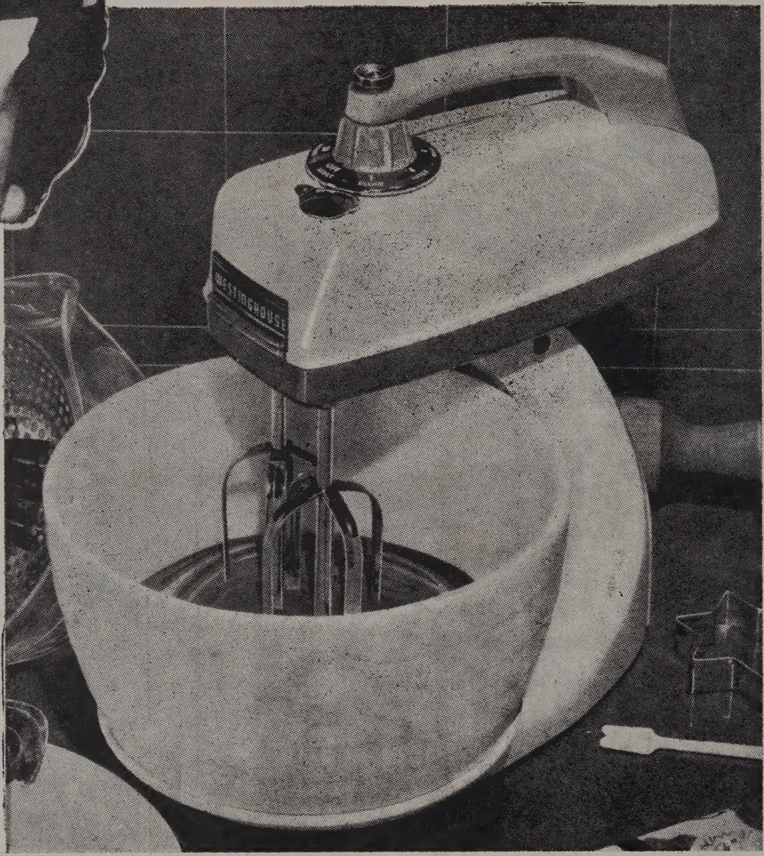
own in a new version of Bruckner's "Romantic" symphony—the fourth and to my mind the most immediately likeable of this generally long-winded composer's orchestral works. It is beautifully played by the Philharmonia on three sides of 33CX 1274-5, and as the spare side is sensibly left blank, the cost is not prohibitive. This by the way uses a revised orchestration made by friends of the composer (but with his sanction) a point which will be noted by devout followers of Bruckner. Columbia's enchanting Viennese operetta series has now arrived at a minor but bewitching Johann Strauss effort. "A Night in Venice" (33CX 1224-5). As usual this is packed with toothsome melodies and sung by the cream of today's singers in this sphere—Elisabeth Schwarzkopf, Erich Kunz and their colleagues. Hans Hotter sings Schubert's deeply moving "Swan Songs", not a cycle in the sense that "Die Winterreise" is one, but a collection of the composer's last and greatest, put together under this touching title by an enterprising publisher. This is on 33CX 1269.

A product of Radiation New Zealand Limited, Brinsley Works, Dunedin.
Available at all electrical appliance dealers.

4HP.2



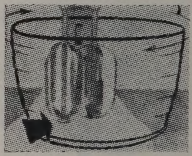
It's here! FOOD CRAFTER by Westinghouse



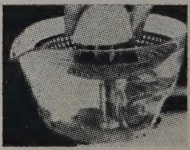
"Every house needs Westinghouse"

Thumb-tip Beater Ejector . . . just touch the button . . . and zipp, out come the beaters.

Mix Dial Up Front . . . swift—visibility of six basic speeds—plus twenty variations.



Merry - Go - Round Bowl . . . assures all ingredients are brought in to beaters for a complete mix.



Pitcher - type Juice Crafter . . . gets ALL the juice! Made of transparent plastic. Graduated in ounces.

The Mixer with the *power* to do everything better! . . . Mixes the *heaviest* batters without "slow down." Long life sealed lubrication *never* needs oiling.

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"Scotchboy" perfected dry lubrication does away with blocking and sticking, with wow and flutter. Strong and non-kinking, plastic-backed "Scotchboy" runs smoothly and gives perfect reproduction at all tape speeds.

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Coercivity . . . . 240-260 Oersteds
Total Remanent Flux. 0.4/0.5 lines $\frac{1}{4}$ in. width
Uniformity throughout a reel . . . 0.5 d.b.

PLAYING TIMES (per track):

Reels	Spool size	$3\frac{3}{4}$ in./sec.	$7\frac{1}{2}$ in./sec.	15 in./sec.
3280 ft.	$11\frac{1}{2}$ in.	160 min.	80 min.	40 min.
3000 ft.	$11\frac{1}{2}$ in.	150 min.	75 min.	$37\frac{1}{2}$ min.
2400 ft.	$10\frac{1}{2}$ in.	120 min.	60 min.	30 min.
2250 ft.	9 5/16 in.	110 min.	55 min.	27 min.
1200 ft.	7 in.	60 min.	30 min.	15 min.
600 ft.	5 in.	30 min.	15 min.	$7\frac{1}{2}$ min.
300 ft.	$3\frac{5}{8}$ in.	15 min.	$7\frac{1}{2}$ min.	$3\frac{3}{4}$ min.

FREQUENCY RANGE:

50 c/s. to 10 kc/s. at a playing speed of $7\frac{1}{2}$ in./sec.

"Scotchboy's" extra sensitivity and ouptut means you can record either at lower levels for the same output with lower distortion or at the same level for increased undistorted output. Signal/Noise ratio is improved as well.

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